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METHODS
OF
ANALYSING FERTILIZERS

1884.
PUBLISHED BY THE
NATIONAL FERTILIZER ASSOCIATION,
BALTIMORE.

METHODS

OF

ANALYSING FERTILIZERS

IN

GERMANY AND THE UNITED STATES,

AND EFFORTS MADE IN BOTH COUNTRIES FOR ARRIVING AT

UNIFORM METHODS AND RELIABLE RESULTS,

PRECEDED BY SOME DATA ON THE

FERTILIZER INDUSTRY IN GERMANY.

COMPILED AND TRANSLATED

BY

A. de GHEQUIER,

Secretary.

PUBLISHED BY THE

NATIONAL FERTILIZER ASSOCIATION

BALTIMORE, MARCH, 1884.

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PRESS OF
GUGGENHEIMER & WEIL,
BALTIMORE.

PREFACE.

The subject of analysis and of commercial valuations of fertilizers claimed the earnest attention of the Board of Directors from the very time of the formation of this association. The great discrepancies between analyses of the same goods in different States, and the practice of assigning commercial valuations to fertilizers on the basis of these analyses, seemed to call for energetic efforts to bring about, in some way, greater uniformity as regards the former and a different *modus operandi* as regards the latter.

With this object in view, the association endeavoured to obtain information on that subject from official sources in European countries and it is gratifying to be able to state that very kind and very full replies to the numerous inquiries made by the Secretary have been received. These inquiries were extended over the number of manufacturing establishments engaged in Germany in the production of artificial manures, their total production and consumption, the control exercised by the government and by the agricultural experiment stations, finally the status of the analysis question. Dr. G. Krause, the proprietor and editor of the "Chemiker Zeitung," responded by forwarding an exhaustive paper, from which copious extracts are made in the following pages. The Minister of Agriculture for the Kingdom of Prussia, to whom the communication addressed to the Minister of Agriculture of the German Empire had been referred, forwarded in a printed pamphlet, compiled by Privy Councellor Dr. H. Thiel, the work of the latter. Then several prominent chemists, who had been written to for full descriptions of the methods used by them in the analysis of fertilizers, obligingly complied with the requests made of them. From the material obtained from these threefold sources and from other official documents the following compilation has been prepared. The Board of Directors concluded to append to it a synopsis of what so far has been done in this country towards accomplishing uniformity of method of analysis, and submits the following pages as the result of the work.

BALTIMORE, MARCH 1884.

The important part which the comparatively young fertilizer industry plays in the German Realm, becomes apparent when it is borne in mind that about four hundred (400) establishments are engaged in the manufacture of artificial manures within its borders.

According to the official import lists, there were imported during the year 1882, 116,150 tons of guano, of which quantity about 52,544 tons consisted of Peruvian guano, while the balance of 63,606 tons were phosphate guanos. These figures represent approximatively an average for a term of 9 years. Besides the above quantities there were imported—

Mineral Phosphates.....20,739 tons.
Bone Meal (exclusive of export).....32,354 "

And used

Phosphorites and Coprolites from German Mines...38,718 "
German Bone Meal, &c.....41,478 "

Of this aggregate quantity, viz: 249,439 tons were manufactured in German factories—

38,713 tons	Peruvian Guano, requiring		12,997 tons	Sul. Ac.
63,600 "	Guano Phosphate,	Requiring about 50 per cent. Sulphuric Acid.	159,278 "	"
9,402 "	Phos. of var. kinds,			
20,740 "	Imp. Mineral Phos.			
73,832 "	Bone Meal, bone blk			
38,713 "	Nat. Phos. Rocks, @ 75%		29,035	
245,000 "	Raw Material, requiring		201,310 tons	Sul. Ac.

The quantity of Sulphuric Acid tallies with the fact that of the total productions of this article in 1882, after de-

ducting export and adding on import, about 298,647 tons were consumed, of which fully ⅔ found employment in the manufacture of fertilizers. The quantity of raw material on the other hand, tallies with the estimated production of fertilizers as made by the Association of German Fertilizer Manufacturers.

Under the supposition that the superphosphates contain on an average 15% of soluble phosphoric acid valued at 9c. per pound or $24 per ton,

The total production represents a value of	$9,246,300
To this must be added	
About 121,671 tons Chili-Saltpetre	6,806,800
" 44,244 " Sulph. Ammonia	3 998,400
" 58,070 " Peruvian Guano " 5,530 " Fish Guano.	3,010,700
" 24,889 " Imported Bone-meal " 55,305 " German do.	2,415,700
Making a total of	$25.477,900

This does not include blood and horn and hoof preparations, &c., nor Potash–salts of which were consumed,

29,865 tons Kainit by farmers	$122,094
22,122 " Chlorkalium by farmers	725,900
2,765 " Kali-Magnesia	40,460
11,061 " Salts of other kinds	36,220
About 65,813 tons of the value of	$924,674

How much all other classes are interested in and affected by the fertilizer industry appears best from the consideration that the freights on raw and manufactured manures and materials amount to about 2 million dollars; that ⅔ of the products of Pyrites-mines are consumed by it; that bag factories depend upon it to the extent of bags for 663,660 tons, representing nearly $600,000; that the iron and coal industry is constantly engaged in keeping factories supplied with machinery and coal, the farmers in raising food for nearly 20,000 laborers, the banking establishments in furnishing credit to the trade to the amount of 15 to 20

million dollars, finally the tax-departments in levying at least 1,000,000 dollars on real-estate, &c., depending upon or belonging to this industry.

In the quantity consumed there were contained about 150,000,000 lbs. Phosphoric acid and 63,000,000 lbs. of Ammonia, which, calculating 20 pounds to the Morgen (1 Morgen=1¼ acre) would indicate that about 10 million acres have been supplied in 1882 with artificial manures. With the steady progress in the application of fertilizers, the German industry will before long be confronted by the task to supply fertilizers for about 58 million acres, which constitute the area of Germany under agricultural cultivation, hence it will have to become twenty times larger than it is now. From this consideration results as it is stated the duty of the government to protect this industry and to prevent by a duty on imported, particularly English fertilizers, a competition fatal to the prosperous expansion of the German industry. It is a matter of national interest in the estimate of Germany to see this industry grow vigorously and to encourage capital to make investments in it.

The foregoing extracts and condensations from the report of Dr. Krause do not claim to give absolutely correct statistical information, yet they possess enough intrinsic value to serve as a measure of the magnitude and importance of this industry in Germany. The following data have been compiled here from tabulated statements which, in their original form would hardly have given a correct insight into the commerce of Germany with other countries in articles dependent upon the fertilizer industry.

The imports during the year 1882 of natural guanos, crude potash, nitrate of soda, sulphate of potash, muriate of potash, and other fertilizer materials amounted to 467,739 tons, while the exports of the same articles for the same year consisted in 326,039 tons.

For the first 6 months of the year 1883 the respective figures are: Imports, 244,631 tons; Exports, 139,428 tons.

A communication, dated Berlin, October 4, 1883, from the ministry of Agriculture, Domaines and Forrests con-

tains the following significant passages: "The manufacture of artificial manures is *perfectly free* and in no way hampered by restrictions. About the mode of *voluntary* (not obligatory) control which the agricultural experiment stations exercise over the fertilizer-trade, you will find full information in Dr. Thiel's work"

Privy Councellor Dr. H. Thiel begins his pamphlet "on the consumption and control of artificial manures in Prussia" with an expression of regret that correct statistical information regarding consumption cannot be given. This alone, he says, would furnish a reliable gauge for measuring the intensity of the cultivation of the soil (high-farming), thus identifying agricultural progress with the development of the fertilizer industry. It would, moreover, he contends, be the means of indicating to what extent care is bestowed upon the preservation of the fertility of the soil and enable us to draw valuable conclusions in regard to the elements of plantfood required by the various crops and modes of cultivation. Last, but not least, he thinks that data of consumption would be the best argument against a saying which, strange to say, has not yet entirely lost currency, viz: that artificial manures on certain soils are inefficient and valueless. But, he adds, that only in districts which are very much behind the times in agricultural progress is this absurd statement heard, since it is quite certain that the farmer cannot attain the maximum yield from the soil without providing by artificial means the indispensable plant nutriment. Apart from this consideration it is, he says, of great importance to know the manner in which the trade in fertilizers is being done and the character and quality of these artificial manures. In this last respect Germany points with great and just pride to the development of this industry. The numerous agricultural experiment stations which originally were established for the investigation of purely scientific questions, rendered incalculable services to agriculture by devoting themselves to the rather monotonous task of exercising a certain control over artificial manures. The old mode of selling fertilizers, called by a generic name

(brands), has been replaced by one where the analysis furnished with the goods determines their character, and even this mode is now already being superseded by a still more rational way. Farmers no longer buy so and so many bags of guano or bonemeal, &c., but order from the manufacturers so and so much of each desired plant-nutriment, viz.: phosphoric acid, ammonia and potash and the price of these ingredients is quoted to them. This stage of transition to the most rational mode of dealing between farmer and manufacturer is now obtaining throughout Germany. Representatives of the fertilizer-industry endeavored at various times to have the government establish a compulsory control of fertilizers and uniform regulations applicable to the whole trade, but this has been opposed by the Agricultural Experimental Stations and Agricultural Associations, as inopportune and by no means required by the existing state of affairs.

The following agricultural experiment stations, Insterburg, Königsberg, Danzig, Eldena, Regenwalde, Dahme, Posen, Breslau, Kiel, Halle a. S., Hildesheim, Göttingen, Münster, Bonn, Marburg and Wiesbaden exercise in the Kingdom of Prussia, a control, mutually agreed upon between each station and factory, over about 220 manufacturing establishments. As regards the mode of control exercised by these agricultural experiment stations over the fertilizer-trade, Germany, as appears from the reports received, passed through the same stages through which Belgium passed and as the result was in both countries the same, it is well worth while to go more fully into the subject.

In the first place the stations interfere in no way with the selling-prices, nor with the stipulations of the sale-contracts made by the manufacturers.

In the second place the stations assume control over the products of such factories only, as voluntarily report themselves, that is, desire to sell their goods subject to the control of the various agricultural experiment stations. In all such cases, namely, in cases where factories sell subject to the control of stations, these are notified of the sale-conditions.

and as appears from numerous forms of contracts appended to Dr. Thiel's report, the stipulations are pretty uniform. The purchaser must draw a sample according to the mode prescribed in the contract in presence of one or two witnesses, divide this into 3 equal portions and forward it to the station. This must be done, however, inside of a fortnight after the receipt of the goods. The chemist of the station, or the chemist agreed upon in the sale-contract, then analyses the sample and a discrepancy of 5-10% in phos. acid, 3-10% in am., and 5-10 in potash is not considered an evidence of shortage of valuable ingredients, because the chemists concede that such differences, in spite of close observation of the same method of analysis, are unavoidable. Any greater shortage is allowed for at a certain price agreed upon between buyer and seller, an excess of one ingredient being considered an offset to a shortage in another. *It is the manufacturer who in all cases determines the value of phosphoric acid, ammonia and potash and not the station.*

As Dr. Thiel well remarks, the differences established now and then, are so small that the control in no way impedes the healthy development of the fertilizer industry and the same deserves in his opinion to be called as so honest and clear a trade that one would wish the same could be said of the trade in seeds and feeding articles. All this applies to the present state of affairs since December 18th, 1881.

Prior to that date there existed the same lack of uniformity in the results of analyses, which is the source of so just complaints in this country.

From letters received from Prof. Dr. Fresenius at Wiesbaden; Dr. Ulex, Hamburg; Dr. Hugo Schulz, Magdeburg; Dr. Saxhlot, Munich, and Prof. Kroker, Breslau, and from pamphlets published on the subject of analysis of fertilizers, it appears that several conventions of agricultural chemists, directors of experiment stations, and manufacturers, were held before uniformity in the method of analysis was established. The first of these conventions was held

at Madgeburg in 1872, then followed those at Danzig and Munich, and, finally, on December 18th, the last one at Halle a. d. S., which resulted in the adoption of the following:

METHOD OF ANALYSING FERTILIZERS

According to the agreement made by the Directors of Agricultural Experiment Stations, Chemists and Manufacturers in Convention assembled at Halle on December 18th, 1881.

A.—PREPARATION OF SAMPLES IN THE LABORATORY.

1. Dry samples may be put through a sieve for the better breaking up of lumps, if this on account of a lumpy condition appears desirable. But whatever remains on the sieve should be as thoroughly broken up as to pass finally through the sieve, and this portion should be thoroughly mixed with the portions that passed first through the sieve.

2. With moist samples the use of the sieve is impracticable; the preparation of the sample is then confined to a thorough mixing in the mortar.

3. The weight of samples should be determined on their arrival and the *whole* sample should be prepared and preserved in glass jars with tightfitting stoppers, if possible in a cool place.

4. When balances of samples are to be forwarded, either the whole balance should be sent to the controlling chemist or a thorough mixing of the whole balance should take place before dividing it.

In case of crude phosphates and of bone-black, the moisture should be determined for the purpose of identification at a temperature of 100°C with the former and 130°C with the latter.

In case of fertilizers which during the process of drying loose carbonate of ammonia, this should be determined.

5. Chemists should endeavor to receive only carefully drawn samples, packed in tight vessels and at least 500g weight.

B.—DETERMINATION OF SOLUBLE PHOSPHORIC ACID IN SUPERPHOSPHATES.

I. Method of Extraction.

1. 20g of the sample are treated with water in the mortar, slightly pressed with the pistill without finely triturating and washed into an 1 litre-flask.

2. After this operation the flask is at once to be filled up to the mark.

3. All superphosphates have to be digested for 2 hours, at the temperature of the room under frequent shaking and then are filtered.

4. The volume of the insoluble is diregarded.

5. In case of superphosphates containing not much more than 20% of phos. acid, 200CC of the filtrate are mixed with 50CC of a solution of acetate of ammonia (:100g pure acetate of ammonia and 100CC of concentrated acetic acid to 1 litre:) for the purpose of separating the phosphates of iron and alumina. The deposited precipitate is filtered, washed 3 times with hot water, burnt out and weighed and calculated as consisting of $\frac{1}{2}$ of the weight of phosphoric acid.

6. In case of superphosphates containing more than 20% of soluble phosphoric acid 100CC of the filtrate are diluted with 100CC of water after adding 50CC of the acetate of ammonia (as above described).

II. Volumetric Determination of Phosphoric Acid.

1. This process can be used with all superphosphates containing not more than 1% of phosphoric acid in combination with iron or alumina.

2. For the titration a solution of pure nitrate of uranium has to be prepared. To obtain the normal concentration (:1CC=0.005 g phos. acid:) 1000 g of nitrate of uranium are dissolved in 28200CC of water and 100 g of acetate of ammonia solution added to neutralise the small quantities of free nitric acid generally present.

3. The titre is determined either by the use of a solution of the superphosphate, free of iron, containing about

16% sol. phos. acid or by a solution of 7.5 g tricalcium phosphate in a corresponding quantity of sulphuric acid.— During the titration the same proportions of solution of phos. acid with acetate of ammonia are to be observed as in the case of superphosphates.

In each case the percentage of phosphoric acid of the control-liquid has to be determined by the molybdaen-method.

4. In executing the analysis, 50CC of the filtrate from the phosphate of iron are to be used and not to be diluted with washwater. The end of the reaction is determined after strong boiling on a porcelain plate either by a finely powdered ferrocyanite of potassium or a freshly prepared solution of the same.

III. Execution of the Gravimetric Determination of Phosphoric Acid by Molybdaen.

25 to 50CC of the phosphate solution containing from 0.1 to 0.2 g phos. acid are emptied into a beaker and mixed with enough concentrated solution of nitrate of ammonia and enough molybdate-solution (:75 g of molybdate of ammonia dissolved in 500CC water at a temperature of 50 to 60°C and 500CC nitric acid (1.2 specific gravity) after shaking filled up to 1 litre:), so that the total liquid may contain 15% nitrate of ammonia and that for each 0.1 g phos. acid not less than 50CC of molybdate solution be present. The contents of the beaker are heated in a waterbath to 80-90°C, put aside for one hour, filtered and the precipitate in the filter washed with a diluted solution of nitrate of ammonia. The beaker is then placed under the funnel, the filter perforated by a platinum-wire, the precipitate washed with a 2½% ammonia liquid into the beaker, under stirring with a glass-stick, carefully washing out the paper and as much 2½% ammonia liquid added to bring the volume of the whole liquid to about 75CC for each 0.1 g phos. acid, 10CC of magnesia mixture are dropped in under constant stirring and it is then put aside for 2 hours. The precipitate is then filtered, washed with

a 2½% ammonia liquid until the chlorine reaction disappears and then dried. The precipitate with the filter is then put into a covered platinum-crucible, heated until the filter is carbonised, then burnt for 10 minutes with the crucible in an oblique position in the flame of a Bunsen burner, then heated with a blower until perfectly white, placed in the exsiccator and cooled down and weighed.

CONCENTRATION OF SOLUTIONS.

1. *Molybdate solution*, 150 g of molybdate of ammonia in water to 1 litre, poured in 1 litre of nitric acid of 1.2 spec. gravity.

2. *Concentrated solution of Nitrate of Ammonia*, 750 g ammonitrat to 1 litre.

3. *Diluted solution for Washing Purposes*, 150 g Ammonitrat and 10CC nitric acid to 1 litre.

4. *Magnesia Mixture*, 55 g crystallised chloride of magnesium, 70 g chloride of ammonia in 1 litre of 2½% ammonia liquid.

C.—DETERMINATION OF PHOSPHORIC ACID SOLUBLE IN CITRATE OF AMMONIA.

5 g of the original superphosphate are treated under pressure in a mortar by 100CC citrate of ammonia (citric acid dissolved in ammonia to neutral reaction, concentration brought to 1.09 spec. gravity and then per litre 50CC ammonia liquid added), washed into ¼ litre flask, digested one hour at 40°C, then filled up to the mark, filtered and the phos. acid determined in the filtrate, 60CC of magnesia mixture having been added.

There are now generally used

Of precipitated phosphates, 1 g.
" mineral superphosphates, 2 g.
" mixed guanos, 5 g.

D.—DETERMINATION OF INSOLUBLE PHOSPHORIC ACID.

1. *In Bonemeal.* 5 g bonemeal are burnt, the ash dissolved in hydro-chloric or nitric acid, the solution evaporated in a porcelain vessel in the waterbath, until all super-

fluous acid is driven off, taken up with a few CC of acid and filled up to 500CC. Of these 200CC are treated with 50CC acetate of ammonia and titrated.

The destruction of organic substances by chlorate of potassium and hydrochloric acid or nitric acid is admissible in place of burning.

In case of bonemeal treated with sulphuric acid, this second process of oxydation has to be carried out under all circumstances.

2. *In Fish Guanos, Tankage and similar fertilizers.* In these the destruction of organic matter has to be done not by burning but by oxydation by chlorate of potassium and hydrochloric acid or by fusing with soda and saltpetre or soda and chlorate of potassium. If the phos. acid is to be determined by molybdate then nitric acid has to be chosen for the oxydation to which in case of substances which it is difficult to oxydise, 10CC of hydrochloric acid must be added.

3. *In Crude Phosphates.* If organic substance is present, it may be destroyed either by oxydation on the wet plan or by fusion as indicated above. In the latter case the silica has to be separated before the gravimetric determination of phos. acid, which is only necessary in exceptional cases if oxydised on the wet plan. Phos. acid is determined by molybdate."

In the discussion prior to the adoption of the method for the determination of phos. acid soluble in citrate of ammonia (namely, reverted phos. acid) there was considerable difference of opinion displayed. At first, Dr. M. Fleischer, of Bremen, to whom this subject had been referred for report, proposed that the Convention of Directors of Agricultural Experiment Stations and of chemists interested in the manufacture of artificial manures should declare

1. That the method elaborated by Fresenius, Neubauer and Luck for the determination of so-called reverted phosphoric acid by means of citrate of ammonia in its original

form as well as in the form given it by Petermann and the use of these methods for determining the value of phosphates not soluble in water, does not afford any precise (reliable) analytical results.

2. The figures obtained by that method do not afford any measure for determining the agricultural value of such phosphates.

Discussing the first point Messrs. Prof. Maerker, Tollens, Kühn, Wagner, Henneberg, Albert, Brunner, von Grote, Pieper, Schroof and Stelling expressed opinions to the same effect as the reporting Dr. Fleischer. The latter demonstrated by analyses the unreliability of these methods and laid stress upon the fact that temperature, proportion of solution to quantity of sample, time of digestion, condition of the citrate solution according to the mode of its preparation, the presence of other substances, the degree of pulverisation, &c., materially influence the results, so much so that they make these methods absolutely impracticable. This applies as well to the determination of phosphoric acid in precipitated phosphates as also to the determination of so-called reverted phosphoric acid in superphosphates. He refers to the data on that subject laid before the convention at Munich and gives the results of experiments made by himself and others since then which corroborate the former. He emphasises particularly how the more or less breaking up of the sample influences very materially the results.

Professor Tollens advocates oxalate of ammonium, because, as he demonstrated, out of a sample of bonemeal of well-known established value, containing about 15% phos. acid, he could not obtain more than 1% by a diluted citrate of ammonia solution, nor even more by a concentrated solution. The debate closed by the unanimous adoption of the following resolution, offered by Dr. Kühn:

"Notwithstanding the fact that the methods proposed and used for the determination of phos. acid soluble in citrate of ammonia are far from fulfilling their purpose, it is agreed that in case such determinations are asked for, the

method described in §C* be used, but that in each case attention be called to the deficiency of this method."

From this action it is evident that the German chemists did not feel themselves authorized to let the value of a fertilizer depend upon an analysis not absolutely reliable. Yet it is quite certain that this method in the estimate of the chemists attending the convention was the best they were aware of and in spite of this being the case, they acknowledged that even that best method gave results so much at variance, as not to be relied upon and hence they shrunk from inflicting upon the trade, what they admitted would be a great injustice. In Belgium, where there are four experiment stations at Gembloux, Gand, Hasselt and Liège, as appears from a report of Mr. Petermann, the director of the station at Gembloux, there has also been held a meeting of the several chemists during the year 1880 in order to insure uniformity of operations by agreeing upon one analytical method to be adopted by all. The result of this convention was at once communicated to the manufacturers of fertilizers in order to enable them to have the materials used in the manufacture of manures analysed by the same process so as to ascertain exactly what the contents of each material by that method are. (:Unfortunately the exact method's full description has been lost in transit:) It would seem therefore that in those countries which, like Germany and Belgium, pay great attention to the promotion of agriculture, the chemists who exercise any control over the manufactured articles are careful in avoiding what might be understood as a measure unfair to the manufacturer's interests. In all cases the minutiae even of the method are known to the manufacturers so that they unhesitatingly submit to control on part of the experiment station. In this country, however, matters have not yet arrived at this satisfactory point, though several attempts have been made to bring about uniformity of method. There is not even uniformity in the preparation of samples, much less a careful adherence to one and the

*See page 14.

same method of analysis. If the efforts made up to this time by State chemists and other leading agricultural chemists are reviewed, it will be seen that the chemists themselves admit that the present unsettled state of affairs in the analysis question is far from meting out justice to the trade.

For the sake of giving full information to all interested in this subject the minutes of the various meetings of chemists are here reprinted without any abbreviations.

CONVENTION
OF
AGRICULTURAL CHEMISTS
AT WASHINGTON, D. C.

The following circulars will explain in brief the object of the Convention:

DEPARTMENT OF AGRICULTURE,

ATLANTA, GEORGIA, May 20th, 1880.

DEAR SIR:

The experience of the last fertilizer season has suggested to my mind the importance of securing such uniformity of method in determining, by chemical analysis, the percentage of valuable ingredients in commercial fertilizers, as will give more uniform, and hence more satisfactory results. This is especially desirable in determining reverted phosphoric acid.

With a view to accomplish so desirable an object, as well as others which may be deemed proper, I have the honor to suggest the calling of a Convention of the several Commissioners of Agriculture, representatives from State Boards of Agriculture, State Chemists, and Professors of Chemistry in State Universities, and State Agricultural Colleges, in those States using large amounts of commercial fertilizers, to meet at some convenient point early in the month of July next.

I would be glad to have your views on the subject; and if favorable to the suggestion, please nominate some gentleman, who, by general assent, may be informally authorized to fix the time and place of such Convention, and issue the necessary notices.

You are also requested to give me the names and post-offices of gentlemen in your State, holding either of the positions above indicated, which do not appear in the list below, that copies of this circular may be sent to them.

An early reply is desirable.

Very respectfully,

J. T. HENDERSON,

Commissioner of Agriculture.

DEPARTMENT OF AGRICULTURE.

ATLANTA, GEORGIA, July, 1, 1880.

DEAR SIR: I am gratified to announce that the recent circular letter which I had the honor to issue, suggesting the calling of a Convention for the purpose of adopting a uniform system for the analysis of commercial fertilizers, has met with favorable responses from a large majority of the gentlemen to whom it was sent. A like majority has imposed upon me the duty of fixing the time and place of said Convention, and issuing the necessary notices for the same. After correspondence with others, and due consideration of the interests involved, I have decided upon Wednesday, the 28th of July, as the time, and Washington, D. C., as the place, for the assembling of the proposed Convention. You are accordingly, respectfully and earnestly invited to be present and participate in the Convention.

Every reasonable facility for the deliberations of the Convention will be afforded by Hon. Wm. G. LeDuc, Commissioner of Agriculture, who is in hearty sympathy with the object sought to be accomplished. I have appended hereto a list of names of gentlemen to whom this circular will be sent.

Trusting that you will find it convenient to attend and give the Convention the benefit of your experience, and *requesting that you will at once inform me by letter whether you will attend*, I am respectfully,

J. T. HENDERSON,
Commissioner of Agriculture.

PROCEEDINGS

LIBRARY HALL, July, 28, 1880.

In response to these circulars there assembled—in one of the spacious halls of the Department of Agriculture, which was kindly set apart by the Commissioner of Agriculture—the following gentlemen :

Prof. R. M. Ballentine, United States Department of Agriculture.

Dr. C. Elton Buck, Analytical Chemist, Wilmington, Delaware.

Hon. A. P. Butler, Commissioner of Agriculture, State of South Carolina.

Dr. Peter Collier, Chemist of the United States Department of Agriculture.

Dr. M. G. Ellzey, Prof. Virginia Agricultural and Mechanical College.

Dr. C. A. Goessman, Agricultural College, Amherst, Mass.

Prof. W. M. Habirshaw, Analytical Chemist, New York City.

Hon. J. T. Henderson, Commissioner of Agriculture, State of Georgia.

Dr. E. H. Jenkins, Connecticut Agricultural Experiment Station.

Dr. A. R. Ledoux, North Carolina Agricultural Experiment Station.

Dr. G. A. Liebig, Analytical and Manufacturing Chemist, Baltimore, Md.

Prof. Arthur T. Neale, New Jersey State Experiment Station.

Dr. N. A. Pratt, State Chemist, Georgia.

R. W. L. Rasin, Manufacturer, Baltimore, Md.

Dr. Charles U. Shepard, Jr., Chemist, State of South Carolina.

Dr. W. Simon, Analytical Chemist, Baltimore, Md.

Dr. C. C. Wellington, United States Department of Agriculture.

Dr. H. C. White, Prof. University of Georgia.

Dr. P. B. Wilson, Analytical Chemist, Baltimore, Md.

Dr. Theo. R. Wolf, Prof. and State Chemist, Delaware.

The Convention was called to order at 3:30 P. M., by Dr. C. U. Shepard, Jr., who nominated Hon. J. T. Henderson for President of the Convention, reminding the gentlemen that it was owing to Judge Henderson's earnest efforts that they were brought together. Judge Henderson, being called to the chair, after thanking the Convention for the honor done him, stated the object of the meeting as substantially set forth in the circulars above given.

Dr. A. R. Ledoux was then elected Secretary of the meeting.

Dr. M. G. Ellzey addressed the Convention, saying that he heartily endorsed the effort which Judge Henderson was making to secure uniformity in the analysis of commercial fertilizers. He recognized the need of some general understanding in the matter, and hoped that the discussions would take no limited range, but deal with more than one of the questions which have been the cause of difficulty between producers and farmers throughout the country.

Letters were read from Prof. S. W. Johnson, of New Haven, and others, heartily endorsing the object of the meeting, and thanking Judge Henderson for his action in calling the same.

On motion of Dr. Ellzey the chair appointed a committee on a programme, or order of business, to recommend to the Convention what topics should be discussed. The following committee was appointed: Drs. Goessman, Buck and White. The committee recommended the following programme. The report was received and adopted.

PROGRAMME.

1. Preparation of the roll of the Convention, and decision of the right of parties present to participate in the discussion of various topics, and to vote upon the final judgment of the same.

2. Discussion of the method of estimating soluble phosphoric acid.

3. Discussion of the method of estimating "reverted" phosphoric acid.

4. Estimation of insoluble phosphoric acid.

5. Estimation of nitrogen.

6. Estimation of potash.

The Committee consider the above the main topics which should receive the consideration of the Convention. Other points proper for discussion, should time allow, are, perhaps, as follows:

7. Methods of arriving at commercial valuations.

8. Agricultural and commercial valuation of "reverted" phosphoric acid.

In accordance with section 1 of the Order of Business, the Secretary was ordered to make out and read the roll of the Convention, together with the occupations and professions of the gentlemen present.

Dr. White moved that only those who are practicing, analytical chemists, be considered entitled to vote on the final judgment of the meeting.

Dr. Ellzey opposed the motion, saying he would very much regret to see the Convention limited in that way.

The Secretary called attention to the fact that all the gentlemen present, but three,* were practicing, analytical chemits, and entitled to vote under the above resolution.

After some further discussion, the resolution was adopted.

The Convention then, on motion, took up the discussion of the 2nd section of the programme—determination of soluble phosphoric acid.

Drs. Goessmann and Ellzey gave their opinions as to the extent and direction which the discussion should have.

*Messrs. J. T. Henderson, A. P. Butler and R. W. L. Rasin.

It was moved by Dr. Ledoux that a committee of three be appointed by the chair to propose to the Convention a method for the determination of soluble phosphoric acid.

Dr. Collier moved to amend, by substituting "five" for "three."

Dr. Shepard moved, as a substitute, that the entire question of the determination of phosphoric acid, in all its forms, be referred to a committee of five.

After discussion, the following resolution was adopted.

"*Resolved*, That a committee of five be appointed by the chair to consider sections 2, 3 and 4 of the Order of Business, and report thereon."

The following gentlemen were appointed by the chair: Drs. Shepard, Goessmann, Liebig, Jenkins and Wolf.

On motion of Dr. White, it was ordered that a committee of five be appointed to take into consideration sections 5 and 6 of the Order of Business, and report thereon. Drs. Habirshaw, Wilson, Neale, Buck and Pratt were appointed.

On motion, section 5 of the Order of Business was amended so as to include nitrates.

The Convention then took a recess until 6:30 P. M., to allow the committee time to report.

The Convention came to order at 7 P. M. The committee on sections 2, 3 and 4 (Phosphoric Acid) offered the following report, which, after reading and being discussed by several gentlemen at considerable length, was received and adopted.

REPORT.

It is recommended by your committee to whom was referred the selection of a method for the determination of Phosphoric Acid in commercial manures:

That this convention shall agree to adopt, *provisionally*, the methods recommended by Fresenius, Neubauer and

Luck in their article "On the best methods for the analysis of artificial manures."

Zeitschrift for Analytische Chemie, X pg. 133 with the following suggestions:

1. That the flask containing the residue (after the extraction of the Soluble Phosphoric Acid) and the solution of citrate be introduced into a cold water bath, whose temperature shall be rapidly raised to 40 degrees C., and there maintained for one-half hour, the flask being shaken every five minutes.
2. That the determination of the "Reduced" Phosphoric Acid be indirect.
3. That all the determinations be *gravimetric.*
4. That a committee of two—to be named by the chairman—be appointed to prepare, on the above basis, a detailed method for the analysis of commercial manures, and to distribute the same among the members of this Convention and others interested by this action.

CHARLES U. SHEPARD, JR.
Chairman of Committee.

The following report of the committee on sections 5 and 6 of the programme (Nitrogen and Potash) was received and adopted.

REPORT.

Of Committee on Estimation of Nitrogen and Potash in Commercial Manures:

I. Determination of nitrogen (total):

(a.) When the three (3) forms of nitrogen are present (nitrates, ammonia salts, and organic nitrogen), a combustion with oxide of copper or plumbic chromate.

(b.) When nitrates are not present, a combustion with soda-lime and the resulting ammonia estimated with Platinum chloride or titrated with a normal solution (alkali).

II. Determination of nitric acid when in presence of ammonia salts and organic nitrogen:

(a.) Nitrates and ammonia salts are brought into water solution and the nitric acid is converted into ammonia by Harcourt & Siewert's process.—Fres. Zeits., 1871, 334; Jour. Chem. Soc., 1862, 381; An. Chem. und Phar., 125, 293; Sutton Volumetric Analysis, London, 3d Ed., 1876, 102 *et seq.*)

(b.) Nitrates are brought into water solution and the nitric acid estimated by Schlossing's method, modified by Schultz, viz., distillation in presence of Ferrous chloride with excess of hydro-chloric acid. The NO gas is collected and measured.—(Schlossing's Original Paper, Annal. de Chim., 3 ser. tom. 40 479; Jourfur Pract. Chemi., 62-142.)

III. Determination of nitrogen existing as ammonia salts: The solution in water is distilled with magnesium oxide and the ammonia estimated either by the Platinum method, or by titration with normal acid.

IV. Determination of the nitrogen when existing in a substance, in separate forms, as nitrates, ammonia salts and organic nitrogen:

(a.) Estimation of total nitrogen by I. a.
(b.) do nitric acid by II-b or II-a).
(c.) do ammonia salts, III.
(d.) do organic nitrogen by difference.

V. Estimation of potash:

Only salts of potash soluble in water are considered in this report (except when the potash occurs in seeds, in which case previous calcination is recommended.)

(a) Solution in water, removal of sulphates, phosphates and magnesia by Barium hydrate, clearing with oxolate and carb. ammonia and precipitating with Platinum chloride.

W. M. HABIRSHAW,
Chairman.

On motion, it was ordered that the two reports be referred to a committee of two, who should copy them, giving *details* of the methods to be employed, and to send to each member of the Convention a copy of the same.

On motion, a letter of Dr. S. A. Goodale was considered and referred to the above committee.

After remarks and discussion of the above reports, it was suggested that, since so many agricultural chemists were present, it would be desirable to effect a permanent organization, to meet from time to time and discuss topics of interest to the profession. Dr. Goessman offered the following resolution:

"Resolved, That this Convention form a section in the subdivision of Chemistry in the American Association for the Advancement of Science, and that their next meeting be held in Boston, during the regular meeting of the aforesaid Association."

On motion, Dr. Goessman's resolution was adopted. Dr. Shepard thought it would be well to refer the matter to a committee to draw up a plan for the permanent organization, and offered a resolution to that effect. Drs. Goessman and Wilson were appointed to arrange for a permanent organization of the Convention, as called for in the resolution of Dr. Shepard.

On motion, section 7 of the order of business was taken up by the Convention. A long discussion followed, which was participated in by Drs. Ellzey, Collier, Jenkins, and others. No final action was taken upon this section, but it will be further considered at the forthcoming meeting of the Convention in Boston. The Committee on Permanent Organization made the following report, which was received and adopted:

REPORT.

The Committee on Permanent Organization propose that Dr. Goessman be made Chairman until the next annual

meeting in connection with the American Association for the Advancement of Science, and that Dr. Ledoux be appointed Secretary.

P. B. WILSON,
Chairman.

On motion, the thanks of the Convention were tendered Judge Henderson for his courtesy and skill as presiding officer.

On motion, the following resolution was unanimously adopted:

Resolved, That the thanks of this Convention are hereby tendered to Gen. Leduc, Commissioner of Agriculture, for his courtesy; and also to Prof. Collier, the Chemist of the Department, for his kindness and attention.

On motion, the Convention adjourned.

The committee who were appointed to write out the details of the methods of determination of Phosphoric Acid have forwarded the Secretary the following

REPORT.

Method for the Determination of Phosphoric Acid in Commercial Manures.

1. Preparation of the sample. It is not to be ground, but may be broken up by hand. and should be thoroughly mixed as rapidly as possible, and transferred to a tightly stopped bottle.

2. Determination of the soluble and "undecomposed" phosphoric acid.

(*a*) Two grammes of the material, transferred to a suitable vessel, are rubbed up with a small quantity of cold water (carefully avoiding any pulverization,) transferred to a filter, and there washed with cold water, which is added at first in small successive portions, until the washings no longer react acid.

Soluble phosphoric acid is determined in the filtrate.

(*b*) The filter, containing the "Reverted" and "Undecomposed" phosphate is carefully spread on a glass plate. With

the aid of a wash bottle containing one hundred cubic centimeters of a perfectly neutral solution of ammonium citrate (sp. gr. 1.09), the residue is washed into a lipped porcelain mortar. The coarser portions are allowed to settle, and the fluid, with the suspended particles, is poured into a small flask. The residue remaining in the mortar is rubbed to a very fine paste and brought with the remainder of the ammonium citrate into the flask, which is then corked.

This flask is put into a cold water bath, the temperature is rapidly raised to 40 deg. C., and there maintained for one-half hour, care being taken to shake the flask every five minutes. It is then removed and the contents immediately filtered.

The residue is washed two or three times with a mixture of equal parts of water and ammonia citrate solution, and used for the determination of "Undecomposed" phosphoric acid,

3. The total phosphoric acid is determined in a separate portion of 1—2 grammes.

The other details are as given by Fresenius, Neubauer and Luck (loc. cit.).

The committee have read with great interest the communication of Dr. S. L. Goodale, referred to them, and beg leave to return it to the Secretary for presentation at a future meeting of the Convention, when its contents may receive the attention they deserve.

CHARLES U. SHEPARD, JR.
EDW. H. JENKINS, } Committee.

The above is respectfully submitted.

A. R. LEDOUX,
Secretary.

J. T. HENDERSON,
Chairman.

PROCEEDINGS OF THE SECOND MEETING OF THE CONVENTION OF AGRICULTURAL CHEMISTS,

Held at Boston, Mass., Aug. 27, 1880.

The meeting took place in the Library of the Society of Natural History, which was kindly set apart for the use of the Convention. The Convention came to order at half-past two. Dr. C. A. Goessman occupied the chair. About twenty-five gentlemen were present.

The minutes of the meeting in Washington were read and approved.

Drs. Caldwell, Kerr, White, Atwater, Sharples and Ledoux, took part in discussions as to the advantage of permanent organization, the choosing of a name, etc., etc. A general opinion prevailed that, for the present at least, it would be sufficient to form a sub-section or sub-division of a sub-section of the American Association for the Advancement of Science. It was suggested by Dr. Clarke, of Cincinnati, that we unite with botanists, practical agriculturists and others, to form a sub-section of agricultural scientists, instead of simply organizing as agricultural chemists. This proposition did not meet with general approval. It was pointed out that efforts were already being made to organize a Club of Scientific Agriculturists; that, in fact, such an organization had been effected the preceding day. It was also stated that such an organization need not conflict in any way with one devoted especially to chemical work relating to and connected with agriculture.

The minutes of the Washington meeting having been approved, the Chairman stated that the next business in order was the reading and adoption of the report of the committee of two, to whom was referred by the Convention (for elaboration and amplification) the reports of the committees on the determination of Phosphoric Acid, Am-

monia and Potash, adopted by the Convention in Washington. The reading of the report brought out considerable discussion as to the methods which were recommended, in which Drs. Atwater, Caldwell and others took part. The reports were adopted provisionally for one year.

Dr. Clarke stated to the Convention that a movement had been inaugurated to have a section of chemistry in the American Association for the advancement of Science, and suggested that this very desirable object could possibly be attained more easily by showing the Association that, not only were the chemists ready to form such a section, but were even ready to form at least one sub-section—of agricultural chemistry—whenever the way was open. Dr. White offered the following resolution:

"*Resolved*, That a committee of three be appointed by the chair to take such steps as may be necessary for securing the formation of a permanent chemical section in the American Association for the Advancement of Science, and the establishment of a sub-section of agricultural chemistry in such permanent section, should it be formed."

The chairman appointed as committee, Drs. White, Caldwell and Ledoux.

An extended discussion was then had concerning the best means for securing the co-operation and adoption of the best methods of analysis by not only the chemists in the Convention, but all those whose duty it was to make analysis of commercial fertilizers throughout the country. Dr. Sharples thought methods endorsed by the Convention would be considered binding by other chemists throughout the country, but considered that experiments should be made fully to establish the fitness of the methods proposed at the Washington meeting.

Dr. Ledoux said that while he thought we would still be more or less dependent for some years upon the thought and experiments of the chemists of the Old World, the time had come when we should make more experiments for ourselves, even if we do nothing more than confirm the methods

and results of Fresenius, Neubauer and Luck, and others. He suggested that many chemists would be glad to institute any experiments needed to attain the end desired, and that the time had come to collate and examine the various methods of determining Phosphoric Acid, Ammonia and Potash, which have, from time to time, been published by our agricultural chemists. He considered that the collection and examination of the methods published and their adoption and reduction to one system, after careful experimental research, would give to the final action of this Convention an authority which would be recognized by every one. Several gentlemen expressed their willingness to make any experiments which might be desired, and to do their share in perfecting a scheme of analysis. The following resolution was unanimously adopted:

"*Resolved*, That a committee of five be appointed by the chair to secure the co-operation and experimental research of agricultural chemists, to collect and examine the various published methods of fertilizer analysis, and to make a report at the next meeting of this Convention; and that we individually pledge ourselves to conduct, for this committee, any experiments or tests which they may desire."

The chair appointed Drs. S. W. Johnson, C. U. Shepard, Jr. Peter Collier, W. O. Atwater and G. C. Caldwell.

It was moved by Dr. Collier, that when we adjourn, we adjourn to meet at the same time and place, in 1881, as the American Association for the Advancement of Science. Adopted.

It was moved and seconded, that the present Chairman and Secretary hold over until the next meeting. Adopted.

On motion, the Convention adjourned.

A. R. LEDOUX,
Secretary.

PROCEEDINGS OF THE THIRD MEETING

OF THE

CONVENTION OF AGRICULTURAL CHEMISTS,

Held at Cincinnati, Ohio, Aug. 18, 1881.

MINUTES.

The meeting took place in the room in Music Hall, assigned to the Chemical Section of the AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Dr. Goessman, the Chairman appointed at the Boston meeting, being absent, the Convention was called to order by the Secretary, A. R. Ledoux.

A large number of chemists were present, among them :

W. O. Atwater, Middleton, Conn.
A. L. Baker, Baltimore, Md.
B. N. Baker, Baltimore, Md.
H. Carrington Bolton, Hartford, Conn.
G. C. Caldwell, Cornell University, N. Y.
H. Y. Castner, New York City.
A. F. Crowell, Wood's Holl, Mass.
C. W. Dabney, Jr., State Chemist, N. C.
E. W. Davison, Baltimore, Md.
G. W. Davison, Baltimore, Md.
F. P. Dunnington, University of Virginia.
Albert C. Hale, Colorado.
T. M. Hopke, New York City.
R. C. Kedzie, University of Michigan.
A. R. Ledoux, New York City.
G. W. Lehmann, Baltimore, Md.
Nat. W. Lord, State Chemist, Ohio.
C. F. S. Lowe, Augusta, Ga.
W. Mager, Baltimore, Md.
J. G. Mattison, New York City.
Lockwood Myricke, Boston, Mass.

Paul Schweitzer, University of Missouri.
W. Simon, Baltimore, Md.
Eugene A. Smith, University of Alabama.
J. Lawrence Smith, Louisville, Ky.
Alfred Springer, Cincinnati, Ohio.
C. M. Stillwell, New York City.
W. P. Tonry, Baltimore, Md.
G. Henry Williams, Baltimore, Md.
P. B. Wilson, Baltimore, Md.
C. Gilbert Wheeler, Chicago, Ill.
H. C. White, State Chemist, Ga.

Letters were read from Drs. Collier, Goessman, Johnson, Liebeg, Neil, and others, regretting their inability to attend the meeting.

In opening the meeting, Dr. Ledoux recited, the history of the Convention so far, and read extracts from the reports of the Washington and Boston meetings, showing what had been done. He called attention to the fact that there had been comparatively little complaint since the Washington meeting, in regard to the results obtained in the determination of nitrogen, potash, total and soluble phosphoric acid; but that, in spite of honest endeavor, on the part of chemists who attended the foregoing meetings, to adhere strictly to the methods laid down and adopted by the Convention, the determinations of insoluble or reverted phosphoric acid have shown the most unfortunate discrepancies. These discrepancies were clearly as great as they had ever been before there was any attempt to arrive at uniformity in method. He said it had been the experience of many that working on the same sample, in the same laboratory, two chemists would get results absurdly at variance, and we have, as far as he could see, come no nearer a solution of the difficulties than we were two years ago. As a proof of this, Dr. Ledoux cited a notable example. Soon after the Washington meeting Dr. Shepard very carefully prepared five samples of artificial fertilizers, and submitted them to a number of chemists specially engaged in agricultural an-

alysis. Each analysis was made in duplicate or triplicate, following most carefully the methods laid down by the Washington Convention, with results simply ludicrous, as far as insoluble phosphoric acid was concerned. These analyses were never published, but being privately circulated among some of the chemists who attended the Washington Convention, tended to prove what many had found out in the meantime by their own experience, that not yet had a method been reached, which, in different hands, would give even approximately uniform results. Dr. Ledoux further stated that another difficulty presented itself in the fact that we have, yielding more or less to our citrate solvent, not only truly "reverted" phosphoric acid, but insoluble phosphoric acid too, in certain mechanical forms; such as in the Peruvian, Orchilla, Curacoa, Bat, and other guanos.

Dr. Ledoux further stated what were the rules as to voting, etc., and the programme for business adopted by the Convention at Washington, and said that these were adhered to in the adjourned meeting in Boston.

Dr. R. G. Caldwell was then called to the chair.

The minutes of the Boston meeting were read and approved.

The reports of committees being called for, Dr. White, Chairman of the Committee on Permanent Organization, reported that their efforts to establish a permanent section of chemistry in the American Association for the Advancement of Science were about to be successful, and that said section would probably be organized on the 19th. After the organization of said section the way would be opened for the organization of a sub-section of agricultural chemists. The report was accepted.

Prof. Johnson, Chairman of the Committee of Five "to secure the co operation and research of agricultural chemists on the present methods of fertilizer analyses," not being present and having forwarded no report, and Drs. Caldwell and Atwater being members of said committee, they were called upon by the Chair for information. They reported that one or two communications had been forwarded to

them by the Chairman; but it was their opinion that no definite conclusions had been arrived at by the Committee.

It was moved and seconded that the rule for voting adopted at the Washington Convention and adhered to in Boston should also govern the present Convention. This rule is as follows: "Only those who are practising, analytical chemists shall be entitled to vote on the final judgment of this meeting." Drs. Dabney, Schweitzer and others, then opened the discussion in regard to the present methods in use for the determination of insoluble or reverted phosphoric acid, calling attention to the dissatisfaction which existed with the present methods, and also showing the difficulties in the way of arriving at any method which would be universally accepted.

Dr. J. Lawrence Smith said that although he had not recently made any especial investigations with fertilizers, he had for years made a study of soils; and he stated that the value of a phosphatic material depended as much on the *soil* as it did on the chemical condition of the phosphate. He considered that there was no such thing as an *absolutely* insoluble phosphate, from an agricultural point of view, and that after the mechanical condition of the phosphate had been taken into consideration, he did not know why some simple method of testing the relative solubility could not be arrived at by agreement. For example, why could we not use a given solution of dilute hydrochloric acid, on a given weight of phosphate, allowing it to act for a given time, at a given temperature; or some other equally simple plan.

Mr. R. W. L. Rasin, President of the Chemical and Fertilizer Exchange of Baltimore, then presented the following petition:

CHEMICAL AND FERTILIZER EXCHANGE,
Rialto Building, Second Street,
BALTIMORE, Aug. 18th, 1881.

TO THE ASSOCIATION OF AGRICULTURAL CHEMISTS:

Gentlemen: The Chemical and Fertilizer Exchange of Baltimore City, of which I have the honor to be President,

and the views of which, on the question of analysis, I respectfully beg to lay before you, is an organization formed for the advancement of the commercial character of this line of trade, and hence actively engaged in watching the closely allied interests of the guano industry, of agriculture, and of agricultural chemistry.

In submitting the following report I beg leave to state that the Exchange, in giving expression to the opinion hereinafter contained, has been guided by the experience of all its members. The grave importance of the decision at which this convention will arrive, will, I trust, be readily conceded, and the Exchange, it gives me pleasure to announce, entertains the firm belief that you will give its views the consideration to which the practical experience of its members—the manufacturers—appears to be entitled.

The method for the determination of reverted or precipitated phosphoric acid in fertilizers, adopted provisionally at the Convention of this Association, at Washington, in July, 1880, has now been in practical operation for over two years, and has therefore undergone a thorough trial, and the result has been by no means satisfactory. The experience of the chemists corroborates the experience of the manufacturer. The Exchange openly avows that the continuance of the citrate method, under the rules adopted at Washington, would be the cause of great dissatisfaction. Yet, in urging upon you the adoption of the oxalate process with specified rules, in lieu of the citrate method, the Exchange urges this change only and solely for the reason that, in their opinion, only the oxalate method metes out equal justice to manufacturer and farmer. The subjoined analyses will forcibly illustrate how the citrate method, under the Washington rules, does crying injustice to the guano trade and to the farmer. For example, a sample of acid phosphate analyzed by that process, allowing thirty minutes as time of digestion, at a temperature of 40° C., using 50 C.C. to 1 gram., gave:

2.75% Soluble
4.54% Reverted } 7.29 Avail. Phos. Acid.

while the same sample, allowing sixty minutes for digestion at 90° C., applying 100 C. C., to 1 gram, showed:

2.62 Soluble
10.71 Reverted } 13.33% Avail. Phos. Acid.

This demonstrates clearly that the citrate method, under the rules adopted at Washington, in July, 1879, fails to show the total amount of available phosphoric acid contained in the sample in question. For, if it were not contained therein, then the second analysis could not make it appear, and hence the reality of the existence of 13.33 per cent. as against 7.29 per cent., as shown by adherence to the Washington rules, is indisputable. Now the manufacturer, as well as the farmer, is entitled to know the true character of the goods offered for sale or bought; the former, because the analysis determines the commercial value of his goods; the latter, because it is his interest to know what he is actually applying to the soil for its amelioration.

But, in all States where analyses are required and made by the respective Departments of Agriculture under the Washington rules, the manufacturer is given credit for much less than his goods are intrinsically worth, and the article is deteriorated in the eyes of the purchaser. The former, on the other hand, is led to believe that he is buying an inferior article, when, in point of fact, the actual ingredients far exceed his expectations.

A similar experiment with ammoniated goods gave the following results:

Sol. Phos. Acid 3.59
Reverted Phos. Acid 8.16 } Total Avail., 11.75%

under 60 minutes digestion, 90° C. and 100 C.C. to 1 grm.; while a strict observance of the Washington rules gave only—

Sol. Phos. Acid 3.59
Reverted Phos. Acid 5.15 } Total Avail., 9.73%

The latter analysis would thus debar from sale this fertilizer in all States where a minimum standard of 10 per cent. is required.

How unjust it is to give the manufactured goods the character of an inferior article when they do not deserve it, how unjust to keep from the farmer the correct information as to what he is buying, need not be dwelt upon here. Suffice it to say, that the adoption of a uniform process, which assigns to each article its true intrinsic value, is an imperative demand recognized by all chemists. Nor is this all. The citrate process, under the Washington rule, has been the cause of much fault-finding with chemists, when, in point of fact, the scrupulously conscientious adherence to the above rules was all chemists could be blamed for. Yet they have been not unfrequently blamed for incorrectness when they sent analyses to manufacturers, which showed considerable less percentage of the various ingredients than the *manufacturer full well knew must be*—as a matter of fact, *was* contained in the goods analyzed from the formula, and proportion in which the ingredients were put in. Thus the method which has been provisionally adopted two years ago, has failed in every respect to be more than a fruitful source of complaint and friction.

It appears, therefore, not only expedient, but absolutely necessary to have a uniform method adopted which will fix the commercial value of fertilizers according to their intrinsic value, and assign also proper value to all phosphatic sources. Science must render a service to agriculture by giving the farmer correct, reliable information as to what he is buying, and another service to the fertilizer trade by giving their goods the credit they deserve. As is well known, of all constituents of a fertilizer, the most important factor is the available phosphoric acid (whether derived from phosphate of lime or phosphate of iron), and the larger percentage of this is mostly furnished in the reverted or precipitated phosphoric acid.

The oxalate process, which this Exchange respectfully urges upon this Convention for favorable consideration, has,

so far as known to the members of the Exchange, been giving general satisfaction, and has, moreover, been used by many chemists in preference to the citrate method on account of its greater accuracy. It appears less liable to error, has shown the products of the manufacturing establishments to be what the farmer's experience confirmed them to be, by the practical results obtained, and seems therefore, open to the least objection.

In confirmation of this opinion, I beg to hand you a letter of Dr. G. A. Liebig, and analyses by Drs. Liebig, Shepard, Castner, Collier and Ledoux, all of which are respectfully submitted for your earnest consideration.

A. De Ghequier, Secretary. R. W. L. Rasin, President.

Accompanying the foregoing petition were the following papers:

Laboratory of G. A. Liebig, Ph. D.:

Baltimore, Aug. 16, 1881.

A. De Ghequier, Esq.,

Secretary of Chemical and Fertilizer Exchange, Balto.

Dear Sir: Your favor of the 27th ult. duly received. You ask me to give expression to such reasons as I may have for preferring the "oxalate" to the citrate method in the determination of precipitated or reverted phosphoric acid in commercial manures.

Upon this subject I think I can hardly say more than I have said already in the correspondence which you have in your possession, covering replies to interrogations propounded by a Committee of your Exchange. Still, as you desire further expression, I will, at the risk of repetition briefly give a few reasons, which have always been of sufficient weight with me, as a chemist, to cause me to favor the oxalate rather than the citrate method in such determinations. In this conection it is only proper that I should remark that, when the subject was under consideration in Washington, I urged my views, which have always been as

they are now; but being in the minority, I was content with the provisional adoption of the citrate method, feeling sure that time would indicate the correctness and justice of those views more effectually than my simple protest.

In the remarks I make, please bear in mind that when I refer to either method it is with the understanding that it will be carefully and conscientiously followed. You will feel the force of this provision when I tell you it is only within a week or two that a prominent chemist wrote me that he should like to know a method by which all chemists could surely find the same results; to which I answered to the effect that no method would ever insure the correctness of chemists.

In the correspondence before named, I had the pleasure of telling your committee, that identical, or nearly identical results can be reached by either method. The difficulties, however, of doing the work correctly are more numerous with the Citrate than with the Oxalate method, and it is laid down that of two given methods the simpler is to be preferred; which is common sense.

One serious difficulty, I have found, is in the fact that the commercial Ammonium Citrate has a decided acid reaction, rendering the utmost caution necessary, so much so that it became a habit with me to manufacture it for myself; and this precaution becomes more necessary when we are dealing with articles containing ferric and aluminic phosphates. The chemist, not knowing the nature of the article sent him for examination, should, of course, prefer a method which is incapable of discrimination, which, in my opinion, is the case with oxalate, while citrate can discriminate

It is, of course, idle to pretend at this time, that a phosphate containing iron or alumina, if made available, is not as valuable agriculturally and commercially as any other phosphate containing an equal amount of so called available phosphoric acid. Indeed, it is Mulder who goes so far as to attach the greater value to phosphate of iron, and my personal experience warrants the assertion that it is equally as valuable as phosphate free from such combination.

I do not see that I can say anything more than I have already said to your exchange, except that I hope the approaching meeting of chemists at Cincinnati—to which I am prevented from going—may adopt the method open to the least objection, and, as uniformity in results is the thing so much desired—in my opinion, the oxalate method should be adopted provisionally or permanently, as the experience and wisdom of those present may decide.

Hoping this, in conjunction with my former letters, may convey my full meaning.

I am, dear sir,
your obedient servant,
G. A. LIEBIG.

UNITED STATES DEPARTMENT OF AGRICULTURE,
WASHINGTON, Aug. 5th, 1881

W. E. LAWTON, Esq.,

My dear sir:

Your letter of the 2d came duly to hand. Please accept my thanks for your promptness. Now, as to the method of analysis: I can assure you that I am very conservative, and by no means inclined to believe without question that the method adopted is the best one to determine the value of the phosphates analyzed. Of cource, I don't mean their agricultural value, for you and other dealers can alone fix their commercial value. But I am aware that experiments alone upon the crop can determine the relative value of these different forms of phosphoric acid, and as a chemist, even, I could not now say what was the difference between that P_2O_5 soluble in excess of hot citrate of Ammonia, and that in cold; or that soluble in oxalate solution. In fact I do not know that there is any difference in its value to the growing plant. I assure you that in any arguments you may have to advance, you will have in me a listener as free from any prejudice as one can be who has been interested in these matters for twenty years. I hope that the very best method known, or capable of being devised, may be adopted for the analyses of these phosphates, and I am wholly with you to

that end, and I think no agricultural chemist will be willing to oppose such a result being brought about.

Sincerely yours,

PETER COLLIER.

MASSACHUSETTS AGRICULTURAL COLLEGE,
Chemical Department,
AMHERST, MASS., Aug. 9, 1881.

W. E. LAWTON, ESQ.,
President of the Navassa Phosphate Co., New York.

DEAR SIR:

I regret that previous engagements do not permit me, during the short period of time left between the arrival of your sample of phosphate (Aug. 8th,) and the beginning of the Cincinnati meeting, to carry out your request regarding their chemical analysis as directed. As the results of the desired examination cannot be secured, to answer your purpose as specified in your letter, as far as time is concerned, I shall not begin the work until otherwise informed I expect that the Committee appointed by me, as Chairman of the Association of Agricultural Chemists at their Boston meeting—August 1880—Professors S. W. Johnson, Caldwell, Shepard, Collier and Atwater—to investigate farther the various current modes of fertilizer analysis, and to report at the coming meeting at Cincinnati—will do much, directly and indirectly, to reconcile contending views. One of the main objects of our young organization consists in a systematic effort to harmonize the interests of the farming community and the manufacturers of fertilizers, and thereby promote agricultural and industrial progress throughout the country. Please accept my thanks for your confidence.

Very respectfully yours,

C. A. GOESSMAN.

The accompanying analyses were also exhibited by Mr. Rasin with the following explanation:

With a view of showing the relative merits of the Washington Citrate, the "high" citrate, and an oxalate method

of determining reverted phosphoric acid, three samples were very carefully prepared from Navassa guano, as follows: One acid phosphate marked "I," one acid phosphate marked "II," and one ammoniated phosphate. These samples were sent for analysis to nine different chemists with the request that they analyze them by the following methods:

A—The Washington method in all its detail.

B—The Washington method with the exception of using one-hundred (100) cubic centimetres of citrate solution for one hour, at a temperature of 90 degrees C.

C—By using oxalate of ammonia (without any definite instructions as to the amount, time, temperature, etc.)

ANALYSES JULY AND AUGUST, 1881.

	OXALATE.						50 C. C. 40 deg. C. 30 min. CITRATE.						100 C. C. 90 deg. C. 60 min. CITRATE.					
	Liebig.	Shepard.	Castner.	Collier.	Ledoux.	Ledoux.*	Liebig.	Shepard.	Castner.	Collier.	Ledoux.	Ledoux.*	Liebig.	Shepard.	Castner.	Collier.	Ledoux.	Ledoux.*
Acid Phosphate Sample No. 1.																		
Soluble				.75	1.75	1.79			2 75	.75	1.75	1.79			2.62	.75	1.75	1.79
Precip'd				9.48	10.06	10.22			4.54	6.49	5.73	5.89			10.71	11.79	12.66	12.92
Total Available				10.23	11.81	12.01			7.29	7.24	7.48	7.68			13.33	12.54	14.41	14.71
Insoluble				4.90	4.00	4.07			8.52	7.89	8.33	8.40			2.35	2.59	1.40	1.37
Acid Phosphate Sample No. 2.																		
Soluble	2.35	1.58		1.08	1.59	1.59		1.43		1.08	1.59	1.59		1.43		1.08	1.59	1.59
Precip'd	9.13	9.77		9.29	8.08	7.98		8.10		6.29	5.17	5.19		12.09		12.47	12.61	12.52
Total Available	11.48	11.35		10.37	9.67	9.57		9.53		7.37	6.76	6.78		13.52		13.55	14.20	14.11
Insoluble	4.03	3.48		5.10	5.95	6.02		5.30		8.10	8.86	8.81		1.31		1.92	1 42	1.48
Ammoniated Sample.																		
Soluble	2 78	2.36			2.02	2.07		2.27	3.58		2.02	2.07			3.59		2.02	2.07
Precip'd	6.36	7.38			8.19	8.00		7.63	5.15		5.87	5.88			8.16		9.62	9.57
Total Available	9.14	9.74			10.21	10.07		9.90	8.73		7.89	7.95			11.75		11.64	11.64
Insoluble	3.92	2.98			3.17	3.30		2.82	4.71		5.49	5.42			1.60		1.74	1.73
Potash	1.12	1.34			.98	1.05					.98	1.05					.98	1.05
Ammonia	2.76	2.89			2.74	2.72			2.98		2.74	2.72			2.98		2.74	2.72

*These analyses were made by a different chemist in the laboratory of A. R. Ledoux & Co.

THE AVAILABLE PHOSPHORIC ACID, as obtained by the various methods, is inserted below for the sake of showing more plainly the different results:

	OXALATE.						50 C. C. 40 deg. C. 30 min. CITRATE.						100 C. C. 90 deg. C. 60 min. CITRATE.					
	Liebig.	Shepard.	Castner.	Collier.	Ledoux, 1.	Ledoux, 2.	Liebig.	Shepard.	Castner.	Collier.	Ledoux. 1.	Ledoux, 2.	Liebig.	Shepard.	Castner.	Collier.	Ledoux, 1.	Ledoux, 2.
Acid Phos. No. 1				10.23	11.81	12.01			7.29	7.24	7.48	7.68			13.33	12.54	14.41	14.71
Acid Phos. No. 2	11.48	11.35		10.37	9.67	9.57		9.53		7.37	6.76	6.78		13 52		13.55	14.20	14.11
Ammoniated	1.14	9.74			10.21	10.07		9.90	8.73		7.89	7.95			11.75		11.64	11.64

NOTE.—The "moisture" in these samples was not reported. The variation in some of the results is undoubtedly due to a difference in the amounts of this constituent.

Mr. Rasin also handed in letters received from a number of chemists expressing their views concerning the Oxalate method: in some instances disapproving, in others expressing their willingness to abide by the decision of the Convention. Professor Tonry discussed at length the disadvantage of the Citrate method, especially emphasizing the injustice which it did to those fertilizers containing large amounts of iron and alumina, and in which the reversion had been caused by these basis instead of lime. Recent experiments were cited which had been made in England, Scotland and Germany, to prove that in many instances, at least, reverted phosphate of iron was as valuable agriculturally and the equivalent of phosphate of lime.

Dr. Simon called attention to the difficulty of obtaining neutral citrate of ammonia, or of maintaining it after it had been secured, and to the marked effect which was exerted by different degrees of alkalinity produced by the addition of ammonia for the sake of neutralization. In contrast to this, he called attention to the stability of oxolate of ammonia.

He was followed by Dr. Ledoux, who pledged himself, as he thought all chemists present would do, to adopt whatever method the Convention endorsed. He called attention to the fact that the Washington and Boston meetings had each endorsed the method of Fresenius, Neubauer and Luck, *provisionally for one year*, that the year had already expired, and consequently there is now no authorized or official method, so far as American agricultural chemists are concerned. He further called attention to the difficulty of filtering rapidly when the citrate solution is employed, and the consequent discrepancies in point of time which must exist where one solution, filtering rapidly, remained in contact with the solvent for a much shorter period than in the case of another.

Mr. Stillwell said he had used the citrate method for years, and in his hands he finds this method quite satisfactory. He found no difficulty in filtering all solutions containing the citrate rapidly, if proper care was used. He

considered the oxalate and citrate methods, when carried on under the same conditions, entirely the equivalents of each other in guanos and ordinary superphosphates, excepting when iron and alumina were present. In the latter case he had observed great discrepancies. The citrate process seemed to favor superphosphates free from iron and alumina, which, in his opinion, was rather unjust, as, in his experience, superphosphates containing iron and alumina, gave as good results on the field as any others. In his experience, two chamists in the same laboratory could use the citrate method with proper care, aud have their work agree within reasonable limits. The same was true of the oxalate.

In view of the fact that he has tried both methods, and that there was so much dissatisfaction with the citrate, and since he considered them, properly conducted, the equivalents of each other, excepting in the case of iron and alumina phosphates, he had concluded to adopt hereafter the oxalate method.

Professor Lord said he considered that a great part of the discrepancies and variations was due, not so much to the solvent, but to the differences in carrying out the *details*. He hoped that whatever method was adopted, the details would be so clearly and plainly stated that it would be impossible to have any more trouble on this account. He objected to the term "reverted" as not implying the whole truth about the phosphates dissolved by the citrate or oxalate solvent, and suggested tnat chemists adopt the term "Phosphoric acid soluble in——at——deg. C." (whatever solvent and temperature might be adopted). He hoped that not only the methods of conducting the analysis would be very clearly and definitely agreed upon, but that even the apparatus to be used in each case should be specified.

Dr. Lehmann stated that his home was in Weisbaden, that he had studied with Fresenius, and was thoroughly familiar with the method of Fresenius, Neubauer, and Luck, that he knows it was adopted mainly with a view to its application for the analysis of bone products and others where little or no iron was present. He too considers the

difference in method and time of grinding, stirring, shaking and filtering, etc., etc., grave causes of discrepancy. In his experience oxalate of ammonia solutions filtered uniformly well.

Dr. Tonry moved that instead of the so-called citrate of ammonia method, the Convention do adopt provisionally for one year oxalate of ammonia of as a solvent.

Dr. Ledoux stated that there were three interests involved in whatever decision was arrived at by the Convention; the interests of manufacturers, the interests of farmers, and the professional interests of the chemists. Since it was apparently impossible, either in this country or in Europe, with our present lights, to arrive at thoroughly satisfactory methods, rendering it impossible to stand upon entirely scientific grounds in the discussion, chemists *must* consider the commercial points at issue between buyers and sellers, and observe a strictly neutral and just middle ground.

Dr. White said that he had analyzed over 350 samples of fertilizers last year, and found little or no trouble with the Washington method. He not only checks his work by duplicate analyses, but again and again, when the same samples have been returned to him without his knowledge, he has found his previous work corroborated. The new analysis agreed with the former. He acknowledged that his analyses did not always agree with those of other chemists. He stated that we were in posession of but few results making comparison of the Oxalate with the Citrate method, but he did know that "An especial British Commission, after considering the very subject which we are now discussing for over two years, decided that the Oxalate process was the very worst of all, in regard to the discrepancies." Since, as has been stated, we are not all agreed as to what shall be included by the term "reverted," he was earnestly opposed to any change, for the present, from the Washington method, but preferred that the whole subject be again referred to a committee, with instructions to make certain tests which could be suggested. He further stated that we could not base a scientific discussion on the analyses

of the samples of Navassa Guano just reported, because we know nothing as to how they had been prepared, and their number was too few to allow us to generalize from their results. He therefore moved, as a substitute to Professor Tonry's resolution, that the subject be again referred to a committee to investigate and report; and that, until said report shall be made, the Washington method be adhered to.

Dr. Dabney seconded this motion, and he declared that, following the Washington method as nearly as possible, except in a few minor details, his results agreed closely, and he was entirely satisfied with the present system. He, too, had found by experience, that in artificially prepared Reverted Phosphate of Lime, the Washington method was entirely satisfactory, but did not consider it always so in Phosphates containing Iron.

Professor Atwater said he was pleased to see a spirit of concession and harmony in the Convention, and earnestly desired that all interests involved should be carefully considered and harmonized. It being one o'clock, he moved that the Convention adjourn until two. Carried.

The Convention came together at two o'clock, and Professor Tonry insisted that his motion should be put. He reiterated his previous statement that, in many legal controversies in which he has been engaged as expert, the Court favored the Oxalate method as used in Baltimore. He simply desired to press his resolution that Oxalate of Ammonia be adopted, leaving the question of method to be settled in some other manner. He stated that he found the Oxalate method best in point of expedition and accuracy.

Dr. Dabney protested against any change, explained the system of obtaining samples in North Carolina, and of making analyses.

By courtesy, Mr. Tonry withdrew his resolution temporarily, to allow a motion that, in the discussion which should follow, each speaker should be limited to five minutes. Adopted.

Dr. J. Lawrence Smith considered it possible that a fair way out of the difficulty would be to discard the term

"reverted" altogether, and simply report the amount of Phosphate soluble in a given solution, whether of acid or not, as might be agreed upon.

Dr. Dabney again spoke, repeating his convictions that the Citrate method would give equally correct, if not better results, than the Oxalate method.

Mr. Rasin, on behalf of the manufacturers, stated that all manufacturers had been intensely annoyed, and their business interests seriously interfered with by the great difference in the analyses of their goods, and consequently in the great difference in the commercial valuations as applied by the various State Departments. While he, as President of the Chemical Exchange, had presented a petition stating candidly that they favored the Oxalate method, he wished to say that all they wanted was justice and uniformity, and was willing that the Convention should adopt the Oxalate method, or the Citrate method, *with certain changes;* either would satisfy the manufacturers.

Drs. Simon, Lehmann, Ledoux and others followed, discussing the Oxalate method. The last stated that since the European chemists have failed to agree on a definite method, examining the question from a chemical standpoint; since they have been discussing the question longer than we in this country, he feared we, too, would find it impossible to agree on any result. He had found it exceedingly difficult to keep the temperature absolutely within the limits prescribed by Fresenius, Neubauer and Luck, but agreed with Mr. Rasin that we must strive for truth and uniformity.

Dr. Atwater said that the manufacturers had put their case fairly and honestly, and had agreed to abide by the decision of the chemists. It was clear, he thought, that they demanded, and rightly, that our method, if not *just*, should be at least *uniform*. He believed that we should make any change which appeared to approach nearer to uniformity than we are at present, and he stated that it seemed to him that the Oxalate method was a shade nearer uniformity than the Citrate.

Professor Dunnington examined in detail the reports of analyses of Navassa Guano, which had been submitted to the Convention, and pointed out the fact that, although no instruction had been given as to what method should be employed in the Oxalate of Ammonia text, and *definite* instructions had been given for each of the Citrate tests, that the discrepancies with the Oxalate were considerably less than with either of the Citrate methods.

Messrs. Stillwell, Ledoux and others stated their readiness to abide by the decision of the Convention, whatever it might be, as did Drs. Dabney, White and others.

The question being called for, the Chairman decided it was on the substitute offered by Dr. White. Dr. White was requested to put his resolution in writing. It was as follows:

Resolved, That the method provisionally adopted by the Washington meeting be continued for one year, and that the matter of the relative merits of the Citrate and Oxalate methods be referred to a committee of five, appointed by the Chair, to report at a subsequent meeting.

Dr. Ledoux called attention to the extreme improbability of our being able, by any amount of experiment, to arrive at a *scientifically* accurate method, and considered it necessary to simply agree upon the solvent and method to be employed for the coming year, and all stand by the agreement.

The substitute of Dr. White being put was lost by the following vote:

Aye—Atwater, Dabney, Lord, White.

No—Baker, Castner, Crowell, Davison, Lehman, Lowe, Mager, Simon, Stillwell, Tonry, Wheeler, Williams, Wilson.

The following gentlemen were absent or refrained from voting:

B. N. Baker, Bolton, Caldwell, Davison, Dunnington, Hale, Hopke, Kedzie, Ledoux, Mattison, Myricke, Smith, Schweitzer, Springer.

A number of gentlemen explained their votes: The motion was lost.

The question then recurred to the original motion of Dr. Tonry: that Oxalate of Ammonia be substituted for Citrate as a solvent.

Professor Caldwell spoke upon this motion. He had listened to the statements of the various chemists with interest. He considered that the protection had been mainly for the benefit of the *farmers* and that it was time the *manufacturers* were protected a little. He was, therefore, in favor of trying the Oxalate method for a while. It was all a matter of experiment, and if, at the end of the coming year, the Oxalate method is found to be unsatisfactory, it can be readily changed.

The resolution of Professor Tonry being put, it was adopted by the following vote:

Aye—Baker, Castner, Crowell, Davison, Dunnington, Ledoux, Lehman, Lowe, Mager, Stillwell, Simon, Tonry, Williams, Wilson.

No—Atwater, Dabney, Lord, Wheeler, White.

Absent or refrained from voting: B. N. Baker, Bolton, Caldwell, Davison, Hale, Hopke, Kedzie, Mattison, Myricke, Schweitzer, Smith, Springer.

Dr. Ledoux offered the following resolution, which was unanimously adopted:

Resolved, That a committee of seven be appointed to consider the best method, and its details, for the determination of Insoluble or reverted phosphoric acid by the use of the Oxalate of Ammonia; that this committee be instructed to report as soon as possible; and that we pledge ourselves to adopt the method chosen by the committee; that the committee be appointed as follows: one by the Chair, three by the President of the Chemical and Fertilizer Exchange, and three to be the State Chemists in charge of fertilizer control present at the meeting, viz.: Drs. Dabney, Lord and White.

The Chair appointed Prof. W. O. Atwater. The President of the Chemical Exchange appointed Messrs. Lehmann, Simon and Stillwell.

It was moved that a committee be appointed to continue the investigation of the whole subject of the determination of insoluble phosphoric acid, comparing the various methods now in use and reporting to this convention when prepared to do so.

The Chair appointed Messrs. Ledoux, Goessman, Jenkins, Liebig and Stillwell.

It was moved that the committee appointed last year to provide for the absorption of the present convention into the American Association for the Advancement of Science, as a sub-section of chemistry, be continued with full power to act.—Carried.

It was moved that the committee appointed to fix upon the method for determining insoluble or reverted phosphoric acid, by means of oxalate of ammonia, be instructed to report to the secretary of this convention, and that he shall forward copies of their report to agricultural and other chemists throughout the country.

On motion the convention adjourned, to meet upon call of the Chair, provided a meeting was necessary before their organization as a sub-section of the American Association for the Advancement of Science.

(After adjournment nearly all the chemists present, who were not already members of the American Association for the Advacement of Science, joined said Association.)

A. R. LEDOUX,
Secretary.

REPORT.

The following is the report of the committee of seven, appointed for the purpose of preparing the details of the oxalate method. The accompanying letter is also published, as it explains somewhat the action of the committee.

Grand Rapids, Mich., Aug. 25, 1881.

Dr. A. R. Ledoux,
Sec. Conv. Ag. Chemists,
17 Cedar St., N. Y.

Dr. Sir:—Herewith I send you the minutes of the committee appointed to propose a method for determination of "reverted" phosphoric acid by ammonium oxalate.

As Dr. Stillwell, the secretary of the committee, was obliged to hurry away from Cincinnati, and was not to return directly to New York, and, further, as it seemed to him, as well as myself, desirable to submit the draft of the report to the other members of the committee for approval, I undertook to attend to the latter task and forward the report to you. As I left Cincinnati somewhat hurriedly also, I have not found convenient opportunity to forward it until now.

As you will see the committee felt that, under the circumstances, they could do no more now than propose a provisional and temporary plan, but have taken steps toward the proposing of something more nearly adequate to the demands of the case. It was, however, the feeling of nearly all, I think, that the requisite data will be gotten only after considerable research, and that without them it will be impracticable to propose a method that will command, or even be entitled to the following of chemists generally.

Will you please see that Mr. Stillwell has opportunity to correct the proof of the report.

Yours truly,
W. O. ATWATER,
Chairman.

REPORT.

Cincinnati, Aug. 19, 1881.

Report of proceedings of the committee appointed by the Convention of the Agricultural Chemists, Aug. 18, 1881, to prepare directions for the use of ammonium oxalate as a solvent in the estimation of reverted phosphoric acid.

Present—Prof. W. O. Atwater, Chairman, Drs. White, Lord, Dabney, Simon, Lehmann, and Stillwell.

This committee, which has been charged with the duty of proposing a method for the estimation of so-called reverted phosphoric acid by the use of ammonium oxalate as a solvent, finds itself at the outset seriously embarrassed;—on the one hand by the lack of exact information as to what compounds of phosphoric acid are dissolved by ammonium oxalate and under what conditions; and on the other by the facts that so few of the chemists *officially* connected with the work of fertilizer analysis were present at the Convention, and that all such who were present felt themselves, under the circumstances, unable to favor the proposed change.

In the first place it seems best to the committee to propose for temporary use a method which approaches as nearly as may be to those which have already been employed by some chemists; second, to attempt at least some investigations in the hope of obtaining more light upon the action of ammonium oxalate; third, so soon as they shall thus be placed in condition to warrant it, to suggest a plan for the coming year as they have been directed to do.

I. PREPARATION OF THE SAMPLE.

At least 250 to 300 grammes are to be put through a sieve with meshes 3 m. m. square (about one-eighth of an inch). All lumps are to be prepared by grinding in a mortar or by cutting until they will pass through the sieve. The whole is well mixed and an average sample bottled for analysis. Special care must be taken during this operation of sifting that no drying of the sample take place.

2. Determination of the soluble and undecomposed phosphoric acid.

(*a*) Two grammes of the material, transferred to a suitable vessel, are rubbed up with a small quantity of cold water (carefully avoiding any pulverization), transferred to a filter and there washed with cold water, which is added

at first in small successive portions until the washings no longer react acid.

Soluble phosphoric acid is determined in the filtrate.

(*b*) The residue upon the filter containing the reverted and undecomposed phosphates is carefully washed into a lipped porcelain mortar with the aid of a wash-bottle holding 100 c. c. of a perfectly neutral solution of pure, crystalized oxalate of ammonium. Each one hundred cubic centimetres of this solution contains two grammes of the salt. The coarser portions are allowed to settle, and the fluid, with the suspended particles, is put into a suitable vessel. The residue remaining in the mortar is rubbed to a very fine paste and brought, with the remainder of the ammonium oxalate solution, into the same vessel.

A water bath containing 400 c. c. of water for each sample treated is brought to a boil, the flame is removed, and the vessel containing the oxalate solution is immediately placed in the boiling water. It is then left in the water bath for sixty minutes, being shaken every ten minutes. At the end of sixty minutes ths vessel is removed from the water bath and the contents immediately filtered. The residue is thoroughly washed with cold water and used for the determination of insoluble phosphoric acid.

The Chairman and Secretary were directed by vote to prepare samples, and a schedule for experimental work, and to invite the co-operation of chemists for trial analyses of the samples submitted.

The Committee adjourned subject to call by the Chairman.

CHAS. M. STILLWELL,
Secretary.

SUPPLEMENT

To Report of Proceedings of the Cincinnati Convention of Agricultural Chemists.

New York, September 23d.

The following letter from Prof. S. W. Johnson, has only just reached the Secretary, after the foregoing report was printed and partially distributed. It failed to arrive in time for the Cinainnati Meeting, although mailed before the middle of August, owing to misdirection. Owing to the great value attached to anything from Dr. Johnson in the line of agricultural chemistry, and the regret of our Convention at the absence of his report, the Secretary publishes the letter in this form, rather than not at all.

A. R. LEDOUX,
Secretary.

New Haven, Ct., August 14th, 1881.

Dr. A. R. Ledoux,
Secretary.

Dear Sir:

I must beg you to present to the Association of Agricultural Chemists my deep regrets at being unable to make any satisfactory report on Methods of Analyses of Superphosphates. I accepted the chairmanship of the Committee, with appointment to which I was honored at the Boston Meeting, after much hesitation and with many misgivings in view of the probability that I could command neither time nor strength to discharge the duty satisfactorily.

Efforts to effect a meeting of the Committee failèd, because of the wide distances that separate them. Various investigations undertaken in the Laboratory of the Conn. Ag. Exp. Station, although yielding instructive and valuable results, could not be brought to a satisfactory conclusion, being interrupted by the regular and necessary work of the Station, and finally my vacation leisure finds me without the strength to digest the material that has accumulated, and to report the progress attained in a manner at all commensurate with the importance of the subject.

I will state a conclusion that is the result of much experience, viz: that the citrate of ammonia method applied as directed by Fresenius, Neubauer and Luck may easily give reasonably satisfactory results on the low-grade superphosphates usually found in our markets, but that it fails to extract the "reverted phosphates" when their quantity is considerable.

Thus from "Curacoa Guano" so-called. containing 30% of phos. acid, 50 C. C. of Ammonia Citrate, as exactly neutral as it could be made, in ½ half hour at 40° C, with constant and uniform agitation:

Extracted, . . .	% P_2O_5
from 2 grms. Curacoa .	5.6
" 1 " " .	9.4
" ½ " " .	13.7
" ¼ " " .	16.6
" ⅛ " " .	21.0

It is evident, then, that for such phosphates the quantity of solvent must be increased.

In conclusion, I beg to be continued another year on the Committee or preferably to be discharged.

Yours very truly,

S. W. JOHNSON,

Chairman of Committee.

REPORT

Of Analysis Obtained from Samples and Schemes for Experimental Work, Prepared by the Chairman and Secretary of the Committee Appointed at Cincinnati, Ohio, Aug. 18, 1881, Consisting of W. O. Atwater, Chairman, Mess. White, Lord, Dabney, Simon, Lehmann, Stillwell.

In accordance with the request of the committee a scheme was prepared, as follows:

Schedule for tests of Solvent Action of Ammonium Oxalate and Citrate upon Phosphoric Acid in Fertilizers.

In accordance with the request of the committee appointed by the Convention at Cincinnati to propose a method for the determination of so called "reverted phosphoric acid," the following schedule for a series of investigations on the solvent action of ammonium oxalate has been prepared. The plan for the investigation discussed in the meeting of the committee involved determinations of phosphoric acid, soluble, reverted, (by difference), insoluble and total, in samples of Navassa and South Carolina superphosphates, the insoluble to be determined by ammonium oxalate under different conditions as described below. It was proposed rather hurriedly and with the feeling, evidently shared by all present, that it was at best only the beginning of a survey of a narrow portion of the field. In the present schedule, besides the determinations specifically included in that plan, a few others are suggested, to-wit: the action of ammonium citrate by the Washington method upon the same samples, the action of both oxalate and citrate upon samples of the raw phosphate from which the samples of

superphosphates are made and the repetition of at least part of the analyses at a later date or dates to learn the effect of the reversion which may proceed with time.

The work as thus laid out will serve to test, in the samples operated upon, the uniformity or disagreement of results by the different analyses, the comparative action of oxalate and citrate, the solubility of the crude phosphate in the reagents used, and, especially, the effect of the factors named below upon the solvent action of the oxalate.

By "Washington Method" is to be understood the method adopted by the Convention of Agricultural Chemists at Washington, July 28, 1880; See pages 23 and 24.

By "Cincinnati Method" is to be understood the method proposed provisionally and for temporary use by the committee appointed for that purpose at the Convention of Agricultural Chemists at Cincinnati, August 18, 1881. See pages 55 and 56.

The determinations of Total Soluble and Insoluble Phosphoric acid are practically the same by both the above plans, and one of each in each sample will of course suffice.

The directions for extracting soluble Phosphoric acid before proceeding to determination of insoluble by ammonium citrate or oxalate will of course be observed in each case.

A. Study of Solvent action of Ammonium Oxalate under varying conditions.

The factors whose influence it is proposed to investigate are:

I. Concentration of Ammonium Oxalate Solution.
II. Ratio of Volume of Solution to Weight of Substance.
III. Time of Digestion.
IV. Temperature of Digestion.

By the "Cincinnati Method" these are:

I. 2 grms. Ammonium Oxalate Crystals in 100 c. c. of Solution.
II. 100 c. c. Solution to 2 grms. Substance.
III. 60 Minutes,
IV. Initial 100° centigrade, gradually cooled down.

It is proposed to test each of the above factors separately, and by three determinations, to-wit:

One in accordance with the Cincinnati Method, which may be for convenience be designated as "normal," *b*.

One with higher concentration or higher ratio of solution to substance or higher temperature or longer time of digestion, *a*.

One with lower concentration, etc., or shorter time, *c*.

That is, there will be for each factor, one determination, *b*, in which all conditions will be "normal," and two others in which the condition in question will be varied. The normal determination will of course also suffice for the determination of "insoluble phosphoric acid" by the Cincinnati Method, in the comparison between that and the Washington Method.

The Details for each factor will be as follows:

I. Concentration of Solution.

Three solutions of Ammonium Oxalate will be required.

a. 4 grms. crystals in 100 c. c. solution
b. 2 " " " " "
c. 1 " " " " "

The three determinations of insoluble phosphoric acid in each sample will involve:

	Weight of Substance	Weight of am. oxalate crystal.	Volume of Solution	Time of Digestion	Temperature of Digestion.
a.	2 grms.	4 grms.	100 c.c.	60 minut's	Initial 100° C. cld dwn
b.	2 grms.	2 grms.	100 c.c.	60 minut's	Initial 100° C. cld dwn
c.	2 grms.	1 grms.	100 c.c.	60 minut's	Initial 100° C, cld dwn

II. Ratio of Solution to Substance.

Solution as prescribed in Cincinnati Method: for *a*, 200 c.c.; *b*, 100 c.c.; *c*, 50 c.c. Details as follows:

	Weight of Substance.	Volume of Solution.	Time of Digestion.	Temperature of Digestion.
a.	2 grms.	200 c.c.	60 minutes.	Initial 100° C. cld down.
b.	2 grms.	100 c.c.	60 minutes.	Initial 100° C. cld down.
c.	2 grms.	50 c.c.	60 minutes.	Initial 100° C. cld down.

III. Time of Digestion.

For *a*, 120 minutes; *b*, 60 minutes; *c*, 30 minutes.

	Weight of Substance.	Volume of Solution.	Time of Digestion.	Temperature of Digestion.
a.	2 grms.	100 c.c.	120 minutes.	Initial 100° C. cld down.
b.	2 grms.	100 c.c.	60 minutes.	Initial 100° C. cld down.
c.	2 grms.	100 c.c.	30 minutes.	Initial 100° C. cld down.

IV. Temperature of Digestion.

For *a*, 100° C. continuous; *b*, 100° C. initial and gradually cooled as by Cincinnati Method; *c*, 40° C. continuous.

	Weight of Substance.	Volume of Solution.	Time of Digestion.	Temperature of Digestion.
a.	2 grms.	100 c.c.	60 minutes.	100° C. continuous.
b.	2 grms.	100 c.c.	60 minutes.	Initial 100° C. cld down.
c.	2 grms.	100 c.c.	60 minutes.	40° C. continuous.

B. Comparison of Solvent Action of Ammonium Oxalate by Cincinnati Method with that of Ammonium Citrate by Washington Method.

This seems eminently desirable and can be accomplished by one more determination of insoluble phosphoric acid in each sample.

The amount of this work which each of the co-operating analysts would be able to do, was discussed by the committee and it was felt to be of the greatest importance that the schedule be arranged and the work divided so as to secure the best results with the least labor and in the shortest time. If each analyst were to undertake the study of only one of the the above factors the united contributions would suffice for the immediate purpose nearly as well and at much less cost than if each were to go through the whole.

The following schedule will show the amount of work required of each analyst on this basis, taking as an example the series with the first factor, "I. Concentration of Solution of Ammonium Oxalate."

SCHEDULE OF DETERMINATIONS IN ONE SERIES.

	Raw Phosphates.		Superphosphates	
	Navassa	S. C.	Navassa	S. C.
Moisture,	1	1	1	1
Phosphoric Acid.				
Total,	1	1	1	1
Soluble,			1	1
Insoluble in Am. oxalate, I.*a.*	1	1	1	1
" " I.*b.* Cincin. Method	1	1	1	1
" " I.*c.*	1	1	1	1
Reverted, (calculated), "			(1)	(1)
Available, "	(1)	(1)	(1)	(1)
Insoluble in Am. citrate, Washington Method.	1	1	1	1
Reverted, (calculated) " "			(1)	(1)
Available, " " "	(1)	(1)	(1)	(1)

	In two raw Phosphates,	In two Super-phosphates.	In four Samples.
Total,	2	2	4
Soluble,		2	2
Insoluble in am. oxalate,	6	6	12
Insoluble in am. citrate,	2	2	4
In all,	10	12	22

The above schedule cover the ground specifically agreed upon for investigation by the committee. Individuals will naturally supplement these at discretion. It would be well to investigate other materials as apatite, bone, etc. Repetition of the determinations of soluble and insoluble phosphoric acid in the superphosphates at a latter date or dates, to be agreed upon, would be very valuable to test the effect of the reversion that proceeds or may proceed with time. It would also add greatly to the value of the work if analyses could be made of the several portions of the superphosphates which are dissolved in water and in oxalate and citrate and

which are left undissolved. Researches of this latter sort will help materially toward the getting of the fundamental data needed for the construction of just methods of analysis.

Samples of Raw Navassa, Acidulated Navassa, Raw South Carolina, Acidulated South Carolina, were prepared and sent by the Secretary to the members of the committee, also to the following chemists; G. A. Liebig, C. U. Shepard, Jr., S. W. Johnson, G. N. Cook, F. P. Dunnington, C. A. Goessman, G. C. Caldwell, H. W. Wiley, T. R. Wolf, Peter Collier, A. R. Ledoux, F. A. Genth, H. Y. Castner, W. M. Habirshaw, (in some of the packages sent was included a sample of Curacoa guano.)

In order to lessen the work to these Chemists outside of the Committee, the experimental tests desired were apportioned as follows, with reference to the four factors of the scheme.

Raw	&	Acid.	Navassa.	Factor	I.	&	Curacao	By Cin. & Wash.	*Liebig.*
"	"	"	S. Car.	"	I.	"	"		*Johnson.*
"	"	"	Navassa	"	II.	"	"		*Caldwell.*
"	"	"	S. Car.	"	II.	"	"		*Shepard.*
"	"	"	Navassa	"	III.	"	"		*Goessman.*
"	"	"	S. Car.	"	III.				*Wiley.*
"	"	"	Navassa	"	IV.				*Wolf.*
"	"	"	S. Car.	"	IV.				*Cook.*

"The following table gives the results received by the Secretary. The Phosphoric Acid results of Prof. Dunnington, are obtained by the uranium process, those of Dr. Ledoux are the average of two determinations, those of Stillwell and Gladding by a double precipitation or the ammonia magnesic phosphate, checked by a duplicate determination made by the method adopted at the Convention of German Agricultural Chemists held at Halle, in December, 1881, see pages 11 to 15, the results by the two methods differing less than 0.10%

NAME OF ANALYST.	White.	Stillwell & Gladding.	Shepard.	Dunnington.	Ledoux.	Wolf.
MOISTURE AT 100° C.						
Raw Navassa,	3.55	.....	.....	*5.12	3.60	.....
Acid "	9.85	13.93	.....	*23.63	14.55	.....
Raw South Carolina,	1.30	.....	.....	*1.90	1.37	.....
Acid " "	6.50	7.17	.....	*12.70	7.41	.....
Curacao Guano,	8.55	7.80	.....	.....	7.92	.....
TOTAL PHOSPH. ACID.						
Raw Navassa,	28.57	29.81	28.59	27.42	30.72	29.66
Acid "	16.20	15.53	15.69	14.27	16.70	15.84
Raw South Carolina,	26.58	26.38	26.66	25.47	27.64	.....
Acid " "	18.25	17.91	18.34	19.69	20.05	.....
Curacao Guano,	26.50	28.14	.....	.....	.....	.....
SOL. PH. ACID.						
Acid Navassa,	4.15	4.15	4.38	4.18	4.29	4.46
Acid South Carolina,	10.45	10.99	10.81	11.82	11.66	.....
INSOL. BY CINC. PROCESS.						
Raw Navassa,	26.64	27.81	27.71	25.74	28.57	27.72
Acid "	5.47	5.22	4.33	4.42	4.35	4.05
Raw South Carolina,	25.32	24.75	25.09	22.61	25.29	.....
Acid " "	4.35	3.73	4.89	4.65	4.82	.....
Curacao Guano,	15.31	26.26	.....	.....	27.30	.....
INSOL. BY WASH. PROCESS.						
Raw Navassa,	.....	27.61	24.06	18.48	.....	.....
Acid "	.....	.....	3.42	2.80	.....	.....
Raw South Carolina,	.....	.....	21.89	19.80	.....	.....
Acid " "	.....	.....	4.10	2.91	.....	.....
Curacao Guano.	17.05	24.82	.....	.....	10.12	.....

*Determined in Air-Bath at 160°—180° C.

Instead of giving the results obtained by each analyst from the different subdivisions of the four factors, we give below the total averages of the results obtained, selecting the two samples of acid. phosphates.

	Acid. Nav.	Acid. S. Car.
Insol. by Factor I. *a.*	3.25	3.84
" " " I. *b.*	4.64	4.49
" " " I. *c.*	7.12	4.85
" " " II. *a.*	4.60	4.03
" " " II. *c.*	5.51	5.06
" " " III. *a.*	4.80	4.11
" " " III. *c.*	5.10	4.28
" " " IV. *a.*	3.80	4.03
" " " IV. *c.*	5.62	4.84

It seems from the above table, taken in connection with the separate results given in the reports sent, that the concentration of the solution and the temperature at which the digestion is made, are the two most important factors. But there is this to be considered—does either the normal citrate or the oxalate process extract all the so-called reverted phosphates, especially those of iron and alumina? If not, then neither will answer and some modification must be made. The results of a long series of experiments on this point are given in a paper by Mr. Thos. S. Gladding, "on the Determination of Reverted Phosphates." Amer. Chem. Jour. Vol IV. p. 123.

We also call attention to the marked difference between the results of phosphoric acid, especially in the total as given above. Certainly, if such differences are obtained in absolutely identical samples, the method for the determination of phosphoric acid is not yet fully understood. In this connection see papers on the determination of phosphoric acid by F. A. Gooch, Amer. Chem. Jour. Vol. I. p. 391, and T. S. Gladdings, Jour. of Amer. Chem. Sec. Vol. 4, p. 135.

Respectfully submitted to the Committee.

CHAS. M. STILLWELL, Sec.

During the spring of 1883 an experiment was made by the Committee on agricultural chemistry of the Chemical and Fertilizer Exchange. The following method was sent with the samples to the chemists mentioned below.

METHOD.

Pass the sample through a sieve twelve meshes to the inch.

Put two grams of this into a beaker with about 20 c. c. cold water, stir with a glass rod tipped with rubber, let settle, filter Supernatant Liquid into a 200 c. c. flask, repeat decantation five or six times, transfer residue to the filter and continue washing until the 200 c. c. are made up.

Take 50 c. c. of the above and determine Soluble Phosphoric Acid, (P_2O_5) as follows:—precipitate with Molybdic Solution, warm to about 50° C., set aside for three hours, filter, wash with a mixture of one-half Molybdate Solution and one-half water, dissolve in Ammonia Solution, add 10 c. c. Magnesia Mixture *slowly* with constant stirring or rotation of beaker, bring the volume of the liquid up to 100 c. c. with Ammonia Solution, warm to about 50° C., set aside in cool place for three hours, filter and wash. In calculating results add .001 grm. Pyrophosphate Magnesia for every 50 c. c. Ammonia Solution used in washing.

Wash the residue from the two grams with the aid of a wash bottle containing 100 c. c. Citrate Ammonia Solution into a mortar, rub to a fine paste, decant and wash into a flask (about 200 c. c. capacity) with the remainder of the Citrate Solution.

Heat a water bath containing 400 c. c. to 65° C., remove the flame, place the flask in the bath, let stand half hour, shaking every five minutes—the flask must be tightly corked—filter, wash with 100 c. c. of a mixture of equal parts of water and Citrate Ammonia Solution. Incinerate the filter and undecomposed Phosphate, dissolve in Nitric Acid and proceed as in determining the Soluble Phosphoric Acid.

For total Phosphoric Acid, dissolve two grams directly in Nitric Acid, make up to 200 c. c. Take 50 c. c. and proceed as in determining the Soluble. using 15 c. c. Magnesia Mixture.

Determine Moisture in 5 or 10 grams at 100° C.

MEMORANDUM.

The reagents mentioned in the above method are prepared as follows:

Magnesia Mixture, dissolve 55 grams Magnesium Chloride, (fused,) 70 grams Ammonium Chloride in 650 c. c. water, and make up to one litre with strong Liquid Ammonia, (°/₀.)

Ammonia Solution is a mixture of one part strong Liquid Ammonia and two parts water.

Ammonium Citrate Solution is a nentral solution of this salt sp. gr. 1.09. One hundred cubic centimeters of this solution contains about twenty grams of the Crystallized Salt.

Molybdate Solution, one part Molybdic Acid dissolved in four parts Liquid Ammonia, (two parts strong Ammonia and one part water,) and *poured into* fifteen parts Nitric Acid, sp. gr. 1.20. The following will make about two litres. 4 oz. Molybdic Acid, 10½ oz. Strong Liquid Ammonia, 5½ oz. Water, when cold pour slowly into 60 oz. Nitric Acid, sp. gr. 1.20, (about half C. P. Acid and half water,) with constant stirring.

THE FOLLOWING RESULTS WERE OBTAINED.

		State Chemists.						Stillwell & Gladding, N. Y. Two Independent Analysis.		G. A. Liebig, Balto.	W. Simon, Balto.	W. G. Lehmann, Balto.	G. W. Davison, Balto.	E. W. Davison, Balto.
		H. C. White, Ga.	Ex. Method. C. U. Shepard, S. C.	Usual Meth.	C. W. Dabney, Jr. N. C.	W. H. Taylor, Va.	F. A. Genth, Pa.	W. P. Tonry, Md.							
Acid Phosphate "A" Dissolved S. C.	Moisture,	10.65	13.10	X	Owing to pressure of Work results not received.	12.76	15.60	12.66	13.38	X	12.38	12.48	12.52	12.62	13.25
	Soluble,	7.87	9.20	9.14		9.02	9.64	9.28	9.40	9.21	9.56	9.31	9.34	9.27	9.15
	Reverted,	4.71	3.35	3.15		4.94	2.80	1.98	2.46	2.52	2.45	2.29	1.93	2.91	3.11
	Available,	12.58	12.55	12.29		13.96	12.44	11.26	11.86	11.73	12.01	11.60	11.27	12.18	12.26
	Insoluble,	3.03	4.09	3.71		2.17	4.47	5.25	4.44	4.47	4.45	4.67	4.95	3.88	3.74
	Total,	15.61	16.64	16.00		16.13	16.91	16.51	16.30	16.20	16.46	16.27	16.22	16.06	16.00
Acid Phosphate "B" (Dissolved S. C. & Navassa)	Moisture,	8.75	10.52			9.68	14.39	8.85	11.	X	10.10	9.22	8.01		
	Soluble,	6.04	5.50			6.27	7.16	6.79	5.00	X	6.74	6.80	6.78		
	Reverted,	6.16	8.19			5.63	5.99	4.41	8.38	X	4.68	5.06	4.43		
	Available,	12.20	13.69			11.90	13.15	11.20	13.38	13.47	11.42	11.86	11.21		
	Insoluble,	0.63	2.43			2.11	1.77	3.56	.93	.99	2.96	2.51	3.31		
	Total,	12.83	16.12			14.01	14.92	14.76	14.31	14.46	14.38	14.37	14.52		

No allowance is made for washing Solution.

The compiler has been unable to ascertain whether at the last meeting of the A. A. A. S., held at Minneapolis, any action has been taken by the agricultural chemists attending it, and if so, what the same has been. It is believed, however, that the meeting passed without discussing this subject at all.

Messrs. Stillwell and Gladding, however, have gone over the whole ground very carefully and with painstaking minuteness and have from time to time published the results of their investigations. (:Amer. Chem. Jour. vol. iv, No. 2; Chem. News, vol. xlvi, pp. 1831: Amer. Chem. Jour. vol. vi, No. 1:) Their work confirms what the trade has been aware of all along, namely, that the methods at present used in analysing fertilizers do not give accurate, uniform and just results.

As Dr. Atwater stated (see page 50) the manufacturers may rightly demand that the method if not *just*, should be at least *uniform*. It appears also from the views of the chemists expressed in the foregoing pages that the reverted phosphoric acid whether derived from phosphates of lime or phosphates of iron and alumina is a very valuable element of plant food and that the main difficulty exists in determining the contents of that ingredient with uniformity. The discrepancies now existing on that point are so great that it seems hardly in conformity with principles of justice and equity to base upon results so greatly at variance any commercial valuation. Whilst it is true that nearly in all States where the agricultural departments publish analyses and commercial valuations, they are prefaced by some remarks to the effect that this is only a comparative valuation and does not determine the agricultural value of the fertilizer in question, it is also true that the farmer may omit to read these brief remarks and even if he reads them, he may not fully comprehend the meaning conveyed by them, so that it is fair to presume that he is largely guided in his purchases by the higher or lower commercial valuation as given at present.

Then, again, it is well known that the manufacturer is not consulted in fixing upon the unit-prices used each year in each State for the commercial valuations. Phosphoric acid, ammonia and potash are said to be worth so and so much in one State and a different amount in another State and these estimates are understood by the farmer as the value of these ingredients to him at the place he purchases, which is, of course, entirely erroneous. In some States the insoluble phos. acid is taken in consideration in the computation of commercial valuations, in some it is disregarded. For instance in Georgia available phos. acid (soluble as well as reverted) is valued at 10¢ per pound, ammonia at 20¢, potash at 6¢, while in Alabama soluble phosphoric acid is considered worth 12¢, reverted phos. acid 8¢, insoluble 4¢, ammonia 18¢ and potash 5¢, while the same figures in North Carolina are for avail. phos. acid 9¢, ammonia 20¢, potash 6¢; Ohio adopted 12½¢ for avail phos. acid, 5¢ for insoluble phos. acid, 18¢ for ammonia and 6¢ for potash and in Connecticut a graduated scale applies making amonia worth from 26¢ down to 11¢, sol. phos. acid 11¢, reverted 8¢ and insoluble from 6¢ to 2¾¢, potash from 7¢ to 4¼¢. From these few instances it is evident that no uniform standard exists and that these prices are more or less arbitrary. No doubt those who fix upon these prices do it in the belief that these represent fair and just equivalents, but after all, the sincerity and honesty of the intention affords a poor consolation to the manufacturer who finds his goods depreciated in the market. Besides, the prices of raw materials are subject to the same fluctuations as those of any other commodity and are regulated not only by the laws of demand and supply, but other circumstances, and only the buyer of raw material at the expiration of each year could compute the average price paid by him for each ingredient. Even these figures however, would not represent the value of the ingredients in the goods for sale, since time (equivalent to interest), labor and money are being spent by the manufacturer in the conversion of raw material into a com-

mercial fertilizer. Thus the cost of manufacturing is not included, while forming an unavoidable item and the farmer generally believes that at his place a pound of phos. acid, ammonia and potash represents the stated values forgetting that he is so and so many miles from the place at which these values perhaps are correct.

The parental government theory so much detested in this country finds in this practice a unique and inconsistent application and it would seem as if the German policy of letting the manufacturer say what valuations he attaches to his goods, is better calculated to insure uniformity. The law of competition necessarily rules out those who quote very high figures and the laws of trade by being accorded a free play would soon establish certain standard values for each season.

With uniformity in the method of analysis and in the carrying out of the same, resonably uniform results would obtain everywhere and with standard valuations determined upon by the trade, the existing unsatisfactory condition of things would soon be replaced by one equally welcome to chemists, departments and manufacturers. And these two issues once settled, more uniform and less contradictory legislative enactments on the subject of the trade should not remain beyond the precincts of possibility. Most of the grievances are so well recognized by State chemists, commissioners of agriculture and other State officials as serious obstructions to the development of the fertilizer-industry, that it is to be hoped steps looking towards bringing about more harmony and accord will be taken and result in establishing *that* which the trade is justly very anxious to see established.

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